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AND
Electrical Engineer.

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The combined paper, the ELECTRICAL WORLD AND ELECTRICAL ENGINEER, of which the present issue of March 11, 1899, is the first number, will hereafter be sent to all subscribers of THE ELECTRICAL WORLD and of THE ELECTRICAL ENGINEER in accordance with the separate lists of those two journals. Where subscriptions overlap, credit will be extended to the full amount of the unexpired term of the payment, the price remaining as before, $3 per year, for 52 weekly issues. Prompt notification is earnestly requested of any failure to receive the new journal.

NEW YORK, SATURDAY, MARCH 11, 1899.

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SALUTATORY — "ELECTRICAL WORLD AND ELECTRICAL ENGINEER."

"The Electrical World" and "The Electrical Engineer" enter upon their united career with the above title, under a full sense of the fact that the greater opportunities entailed by the alliance imply correspondingly greater responsibility toward the electrical public. This burden we accept, with the assurance to our readers on the part of the management and of the editors that no expense and no effort shall be spared in discharging earnestly the duties thus assumed. Creditable as were the long careers of the component journals, the standard set for the future of the new one is necessarily still higher—a standard, indeed, unattainable without this concentration of forces. In no branch of industry and in no profession does there exist a higher esprit du corps than animates the members of the electrical fraternity, while none more worthily demands the highest and best in its journalistic exponent. THE ELECTRICAL WORLD AND ELECTRICAL ENGINEER will, we trust, never be found wanting as a true and loyal advocate of the electrical spirit and ideals. As a representative of the important field which it will cover, it proposes to rank second to no industrial or engineering periodical in the world, and as the best pledge of its success we count in fullest confidence on the cordial co-operation of every one interested in the advance of the art and science.

AUTOMOBILISM BY EXAMPLE.

Somewhere in one of his essays or books, Mr. Herbert Spencer remarks that the best way to introduce wooden shoes would be to have the fashionable women of society wear them first. Then the habit would quickly permeate downward, and sabots would be all the rage. There is the shrewdness of the cynic not less than the philosophy of the sociologist in this observation. It is a fortunate thing for electric vehicles that at the present moment the ownership of an automobile is one of the signs of being "in the swim," and the process of popularization and vulgarization has begun at the right end, viewed from the Spencerian standpoint. That "tout Paris" had gone an-automobilizing we knew, but it now appears to be the fashion among the royalties of Europe to indulge in exercise in the horseless carriage.

Example and precedent are everything in setting a new fashion, and it is pertinent to inquire how far electrical people have gone to foster the automobile art by actual patronage. We know of but one president of a local lighting company who has an automobile, yet it would seem obvious that many such dignitaries might, by setting the fashion in their own cities, stimulate greatly the consumption of "juice." We know of but one electrical supply or manufacturing company that handles its materials with an automobile delivery wagon. There may be others, but they are doubtless extremely few and far between. Yet here surely is the chance by example and positive demonstration to help along the speedy coming of the new industry from which electricity is to derive an enormous development. Electrical journals may push these things on public attention; but the stimulus needed is the example of the whole electrical fraternity itself going in for automobiles. In the meantime, the manufacturers of these vehicles do not bemoan any lack of orders.

THE SUPPLY OF THREE-WIRE SYSTEMS FROM A SINGLE COMMUTATOR.

There will be found on other pages of this issue a description of the isolated plant of the new Union Railway Station of the Boston Terminal Company. The most interesting feature of this plant is the use of 220-volt generators on a three-wire system, with 220 volts between outers, the neutral conductor being connected into the machine windings through collector rings by an ingenious system invented by Mr. B. G. Lamme, and first put into commercial operation in this plant. Through a direct-current generator with the ordinary commutator the windings of the armature are tapped out to collector rings similar to those of rotary converters, and the brushes bearing upon these collector rings are connected to the terminals of single-winding or auto-transformers (in this use called balance coils). Obviously the middle points of these transformer windings have at all instants a potential midway between that of the direct-current brushes bearing upon the commutator, and the neutral of the three-wire system may be connected to these middle points and may return no little unbalanced current through them without disturbing seriously the equality of voltage between the two sides of the system. This addition of a few parts gives a most ready means of drawing from a generator with one commutator one-half of its full pressure, a means which is applicable to other work besides three-wire systems, such as motor control, etc.

The new method compares very favorably with the several older ones for the supply of three-wire systems. Compared with the standard method of the Edison companies, it cuts the necessary number of dynamos in two, and substitutes for the 110-volt commutators—which call for great weight of copper, great area of contact surface and great friction in order to commutate efficiently—one-half as many 220-volt commutators. On the other hand, the new method offers no means within the machine itself of independently regulating, either by hand or automatically, the voltage delivered to the two sides of the system, and in case of an unbalanced load the more heavily loaded side must get a voltage lower than that on the other side by the added drop in the half armature and the feeders and double that in the neutral. Double-commutator machines, with a single armature and field structure, which are sometimes used for three-wire systems, are under exactly this same disadvantage, the new type of machine showing an advantage over them in the use of one 220-volt winding and commutator in place of two 110-volt windings and commutators. Two hundred and twenty-volt machines of the ordinary type are also used somewhat for three-wire systems, the balance being maintained by means of a small motor generator. The new system does away with the need of the latter, substituting therefor apparatus without moving parts. The independent motor generator may, however, be made of two separate machines coupled together, in which case a compounding may be introduced to give automatic regulation of the relative voltages on the two sides of the system. The new system is only capable of splitting the voltage delivered by the commutator in two equal parts, and is, therefore, not applicable to five-wire or other systems in which an unequal division or a division into more than two parts is required.

PROPORTIONS OF ARMATURE CORES.

In this issue appears an interesting discussion upon the subject of the best dimensions of a dynamo armature core. The old error is clearly pointed out which has so often been revived in the literature of dynamo-electric design; namely, that idle wire in an armature is necessarily objectionable, and that the design which will produce the most efficient armature provides for the smallest amount of idle wire. This fallacy is well recognized among careful designers and writers. It is true that all wire upon an armature which does not cut magnetic flux during the rotation of the armature is inactive, idle, or dead, by comparison with the wire which does pass through magnetic flux; in the sense that it does not contribute any e. m. f. to the circuit. But it is quite erroneous to assume that idle wire per se is objectionable, or that the design which contains a relatively large percentage of idle wire is necessarily faulty. Theoretically speaking, it is quite possible that a dynamo armature with only 90 per cent. of idle wire may give just as much electromotive force as the same armature when having only 10 per cent. of idle wire. This is evident from the fact that the usual formula which expresses the e. m. f. of a dynamo armature is dependent upon the rate of rotation, the number of poles, the number of turns, and the useful magnetic flux passing through the armature from each pole, takes no notice of the proportional length of wire which is active. All that is necessary is that the armature core shall convey a certain quantity of magnetic flux usefully linked with the armature conductors, assuming that the armature core is magnetized to the required degree of saturation. It matters not for the production of e. m. f. whether the pole pieces closely surround the armature on all sides, with little idle wire, or whether the pole pieces are merely pointed at the external surface of the armature with much idle wire. In each case the e. m. f. will be the same. But it may well happen that in the latter case the increased reluctance of the air gaps in the magnetic circuit of the field magnets may give rise to a very objectionable amount of excitation.

Theoretically, the best form of cross-section of an armature core for a minimum length of armature wire is that which has the least perimeter for a given area, and this form is the circle; just in the same manner that the form of field magnet core which gives the least resistance to an enveloping coil of copper wire of a given number of turns is the circular form. Since the circular form would be mechanically difficult to obtain in an armature, the square cross-section is the closest rectangular approach to this ideal, and this is the form which Mr. Hanchett points out as theoretically the best. Such a cross-section permits of a shorter turn of armature wire for a given useful magnetic flux than any other rectangle, and, therefore, the lowest armature resistance for a given size of armature wire. The rule has, of course, to be modified in practice to suit a variety of conditions, mechanical, thermal and commercial, in the manner Mr. Hanchett indicates, and like all other proportions of the dynamo, the proportion of length to breadth of armature is determined by compromise among a number of opposing considerations. If a designer desired to obtain a rectangular armature of maximum e. m. f. for a given length of conductor, he would naturally make the cross-section of the armature core square, with a relatively large amount of idle wire. If, on the other hand, he desired to employ the minimum magnetic reluctance in the air gap, he would depart from the square form in favor of the long rectangle, with a relatively small amount of idle wire, but with a larger armature resistance. If he wanted the maximum cooling surface for a given amount of wasted energy, the rectangular outline would be again different, and if he considered the first cost of materials the rectangular outline would be still different. The design which he actually selects, assuming that he has patiently and intelligently studied it, is one which gives the best aggregate result under commercial conditions.

Strange to say, the fallacy of idle wire, in regard to the best proportion of the armature core for maximum e. m. f., is not encountered among the opinions generally expressed concerning the best form of transformer cores for a maximum e. m. f., although in both cases the principle is precisely the same. In the dynamo armature the magnetism comes into the core from an external source, i. e., the field magnets, and usually only upon one face; whereas, in the

transformer cores, the magnetism does not come from an external source, but is generated within the primary winding. The theoretically best shape of cross-section for a transformer core is generally recognized as being circular, and the theoretically best shape for a rectangular core is generally recognized as being square, because for the same quantity of flux and the same induction density these forms give the shortest length of enveloping turn. The cross-section of transformer cores is usually much more nearly square than the cross-section of dynamo armature cores, principally owing to mechanical reasons; but anyone who would advocate a transformer core of long rectangular cross-section would be instantly regarded as pursuing a chimerical notion, while the fallacy of armature idle wire is not so readily acknowledged. Owing to the simplicity of wire is not so readily acknowledged. Owing to the simplicity of whereas, in the case of the armature core, there are so many other important considerations to confuse the problem and to demand consideration that the fallacy is not so readily exposed.

THE FINANCIAL ASPECT OF LIGHTING CONSOLIDATIONS.

Conspicuous among the central station enterprises of this country has always been the Edison Electric Illuminating Company of New York, upon whose system Mr. Edison worked with his own hands in the plant and in the subway trenches, and with which he has remained in close association. A success from the start, the company has during the last ten years made a most enviable record in the growth of its business, in its steady maintenance of good dividends, in its progressive adoption of worthy improvements, in its conservative treatment of financial considerations, and, above all, in its remarkable hold upon the esteem of its customers and the public in general. Its leading and moving spirit throughout this long period of substantial and ever-increasing prosperity has been Mr. R. R. Bowker, who, surrounded by a brilliantly able staff of his own selection, has made in the central station field a reputation fully equal to that which he has won as publisher, publicist and litterateur. Warnings from such a man against what he deems wrong in modern methods of consolidating electric light and power enterprises should therefore receive the most serious attention.

Mr. Bowker has just issued to his fellow stockholders in the company a circular which must be taken as an emphatic protest against the recent absorption of the corporation, along with other local properties, by the New York Gas & Electric Light, Heat & Power Company, a "deal" now virtually in process of consummation. Some of the details have already been given in the columns of the electrical press. The plan,. broadly stated, is to take up $100 Edison stock in 4 per cent. first-lien bonds at 220, and an offer is made by a banking house to cash such bonds at 85, making the immediate assured price of the stock 187, or a little below current market quotations, around 197. The stock is worth this on the present and prospective dividend earnings of the company, these being, in 1898, not less than 10 per cent. on stock and reaching 14 to 16 per cent. roundly in 1900, when all the plans of the Bowker régime would normally have been carried to completion.

The objections raised by Mr. Bowker are mainly of three kinds. He attacks the form of security, "purchase-money bonds," as being scarcely within the recognition of the law, and intimates also that the plan "seems, in fact, only a method of dilution of stock, in which the holder releases any right to increased dividends." Moreover, the Edison company is selling out too cheaply, as it "has the chief earning capacity of the proposed combination," and "its distributing system could not be paralleled for a long period." Mr. Bowker's second objection is based on engineering technique, and his third goes to the political roots of the question. Before leaving the first, or financial one, it may be stated that the total bond obligations of the new absorbing company would run, as matters stand now, up to the huge total of $39,000,000, which he characterizes as loading a good business "with abnormal charges in bond interest." It is a staggering burden, in all conscience.

Mr. Bowker next asserts that there is no occasion to sell for those who wish to hold on, because the Metropolitan Traction Company would risk its franchise in selling current for lighting, as a competitor; because the needs of lighting and railway circuits do not harmonize; and because, as the maximum demands for current coincide, a traction system would not be at any advantage in the supply of current for light, as to saving in generation plant. Further, Mr. Bowker states that as a matter of fact the Edison system has more surplus power in off hours for storage or other use than has the traction system. This is certainly a most interesting issue that presents itself, and we have occasion to know that the technical situation has been profoundly studied by Mr. Bowker and his accomplished staff. But as to the legal point, we understand that the Metropolitan Company would not itself engage in the lighting industry, and as to the complicated nature of the lighting business, which is wisely insisted on by the critic, it may be postulated that the latest methods of transmission and current transformation take care of the exigencies of all branches. Niagara furnishes an excellent example of furnishing current of every brand from one plant, and while all the difficulties there have not yet by any means been threshed out, there are those eight generators of 40,000 horse-power on the ground, with more soon to come. From Niagara and the transmissions in the West the lighting and traction arts in the cities are learning their new methods of delivering current to the distribution circuits. If there be one distinct goal to which the electrical art is tending it is that of one uniform power house for any given district, for all classes of service. Hence the two maxima in one system should also be more economically cared for than if dealt with separately.

The political situation upon which Mr. Bowker puts his finger is a serious one for every New Yorker. He says in brave utterance for which every one must respect him: "It is a surrender by sale to interests affiliated with the forces of political corruption seeking to possess and dominate New York, tending ultimately, in my judgment, to a popular revolt like that against the Tweed ring, to the subsequent municipalization of industries, and to serious jeopardy of the rights of private capital." It is true that Mr. Bowker belongs to the body that plays Cassandra in American political life, with a trend to pessimism; but no honest man will seek to break the force of his appeal for purity in the administration of affairs. Still, there are one or two aspects of the situation to be urged. If Tammany is not to run all the local public services it is well to have big, strong corporations in charge of them, better able even than some we could name to "stand up and be counted" against a "strike." Moreover, local companies, like manufacturing ones, that play politics, rarely or never succeed ultimately, because at last the voter gets in his work, the fabric of the deal is torn asunder, and costly readjustments become necessary. Possibly Mr. Bowker may have evidence in his possession of this alleged "affiliation" with Tammany, but many will prefer to think it a little doubtful of some of Mr. Cleveland's old bosom friends and allies until the contrary is proved.

The moral of all this is that the new combinations of capital going on need the closest scrutiny on the part of those interested in them; and Mr. Bowker performs a public duty in dissecting the scheme under notice, for the benefit of his fellow-stockholders. Should other securities in it be floated, there will be further need for care. If the wonderful expansive power of the electrical business provides income enough for all its obligations, the warning to go slow, to avoid political intrigue and to deserve the fullest measure of public approval will still not have been uttered in vain.

The Exploitation of the Nernst Lamp.

Our English contemporaries announce that a company has been formed in England known as the "Nernst Electric Light, Limited," with a capital of £320,000, for the manufacture, sale and rental of Nernst lamps in Asia, Africa, Australasia, South and Central America. The prospectus of this new company gives some interesting information about the methods adopted for the commercial exploitation of the new invention. The parent company and the promoter of the new company is the "Nernst Lamp, Limited," which has fixed the price of the rights mentioned at £270,000, of which £65,000 must be paid in cash, and the rest in stock of the new company. The parent company claims to have expended in obtaining its rights an amount somewhat more than the cash payment, so that practically the whole of the stock which it obtains in the new concern will constitute its profits. The capital of the new company is divided into £140,000 of 7 per cent. preferred stock, and £180,000 common stock, £115,000 of the former having already been opened for subscription. The promoting company takes the entire balance, namely, £25,000 preferred and £180,000 common stock. The rights to the invention in other countries are controlled as follows: Austro-Hungary and the Balkan States, Ganz & Co.; Great Britain and the remaining European countries, Allgemeine Elektricitäts Gesellschaft; the United States of America and Canada, George Westinghouse.

Water Power Electric Plant Near New York.

The Bergen & Passaic Light, Heat & Power Company, with a capital of $100,000, has been incorporated by Messrs. C. O. Baker, Jr., of Newark, N. J.; George H. Guy and Herbert B. Coho, of New York, and William A. Linn, of Hackensack, N. J. The company proposes to establish a water-power electric transmission plant near New York City. It will do this by utilizing the Saddle River at Arcola, N. J., where a dam will be built and an electric plant installed. The company will supply electric current for lighting, railway and power purposes. The improvements include the excavating of a lake at the dam site and the use of turbines for the driving of the electric generators; also the use of a storage-battery plant for night service, the battery to be charged by day. Among the incorporators, Mr. C. O. Baker, Jr., is well known to the electrical fraternity. He is the president of the Electrical Exposition Company, which will hold an electrical exposition at Madison Square Garden next May. Mr. G. H. Guy is secretary of the New York Electrical Society.

The Litigation on the Magnetic Blow-Out.

Judge Lacombe, in the United States Circuit Court for the Southern District of New York, on Monday, March 6, denied an application by the Thomson-Houston Electric Company for a preliminary injunction against the Bullock Electric Company, to restrain the latter company from infringing patents Nos. 283,167 and 401,485, issued to Elihu Thomson. The complainant contended that street-car controllers sold by the Bullock Electric Company and containing magnetic blow-out devices were an infringement upon the patents named. The defense contended that the patents were invalid for lack of novelty. The case was exhaustively argued by Mr. Frederick H. Betts for complainant, and by Mr. Arthur Stem, of Cincinnati; George J. Harding of Philadelphia, and Clifton V. Edwards, of New York, for the defendant. The case was first heard on January 20, and then on request of the counsels for the plaintiff was re-heard on February 10.

Street Railway Consolidation in Buffalo.

A syndicate said to consist of Philadelphia and New York investors, backed by J. P. Morgan & Co., has secured a controlling interest in all the important street railway properties in and near Buffalo, including the Buffalo Railway Company, Crosstown Street Railway Company, Buffalo Traction Company, Buffalo & Niagara Falls Railway Company, Buffalo and Lockport Railway Company, Niagara Falls Park and River Railway, and Buffalo, Bellevue and Lancaster Railway Company, also the Niagara Falls and Clifton Bridge Company, owning the upper arch bridge, near the Falls, and the Lewiston and Queenston Heights Bridge Company, the owner of the new suspension bridge now building between Lewiston and Queenston, Ont. The total capital liabilities of the above named properties are about $25,000,000. The list includes all the important electric railways now in operation in Buffalo and vicinity, except the Niagara Falls and Suspension Bridge, which serves the city of Niagara Falls, and the "Gorge Road" (N. F. & L. R. R.), which is in the hands of a receiver. The tracks owned and operated by the consolidated roads aggregate about 287 miles. It may be said on good authority that Mr. W. Caryl Ely, president of the Buffalo & Niagara Falls Railway and the Buffalo & Lockport Railway, engineered the consolidation, and will be the president and organizer of the system.

The Pan American Exposition.

The act appropriating $500,000 for a United States building and exhibit has been signed by the President. A similar act has passed the New York Legislature, and secured Gov. Roosevelt's approval, appropriating $300,000 for a State building and exhibit. On Saturday, March 4, the subscriptions to capital stock reached $1,350,770, making a total of $2,150,770 secured since January 21, 1899, a period of forty-two days. Three hundred and thirty-six incorporators have qualified, and a meeting will be held to elect twenty-five directors, who will have entire charge of the administration of the exposition. The most generally approved plan for the selection of directors was suggested by ex-Senator Laughlin, and provides that a list of all duly qualified incorporators shall be sent to every incorporator, who shall designate fifty names therein and return the list. Then a ballot shall be prepared, containing the fifty names receiving the largest number of votes, and at a regular meeting of the incorporators each one shall designate twenty-five names therein, and the twenty-five receiving the highest number of votes shall be declared elected. All ballots are to be secret. For some weeks past the finance committee has not been soliciting subscription, but as soon as the organization is effected it will go to work again with the intention of securing $2,500,000. The matter of a again with the intention of securing $2,500,000.

The Right to Land a New Cable in Cuba.

A despatch from Washington states that the Secretary of War has asked the Attorney-General for an opinion as to the right of the Government to grant a franchise for a telegraph cable line between the United States and Cuba to the Commercial Cable Company. The State Department decided that it had no jurisdiction in the matter, Cuba being under military control, and referred the case to the War Department, which has in turn referred it to the Attorney-General for a legal opinion as to the validity of the franchise granted to the International Ocean Telegraph Company. A hearing was granted on March 2, and the representatives of the Western Union Telegraph Company appeared to protest against the granting of the application. The Western Union Company claims to be entitled to a monopoly of the cable business between the United States and Cuba until December 5, 1906, by reason of rights granted in 1866 for forty years by the Spanish Government to the International Ocean Telegraph Company, who leased the rights to the Western Union Company. The Commercial Cable Company of Cuba was represented by counsel, who submitted legal arguments. Attorney-General Griggs announced that he would take the matter under advisement and render a decision soon. An elaborate brief prepared by the attorneys for the Commercial Cable Company of Cuba says that the monopoly claimed by the Western Union was obtained by fraud and false representation, and that the monopoly granted by the United States for the right in America was for fourteen and not forty years. In conclusion the brief says: "Fraud lies at the very basis of the Spanish grant, and the materiality of that fraud is stated and restated in the grant itself, and it was a fraud, not on an individual, but on an imperial Government. It was a fraud not alone on one Government, but on two Governments; an international fraud. It was a fraud, the impudence and audacity of which are equalled only by the magnitude and enormity of the fraud itself. It was a fraud without parallel and without precedent." In replying to this contention Mr. Taggart, for the Western Union, called attention to the royal Spanish order issued in 1889, which confirmed and explained the rights of the various cable companies holding concessions in Cuba. This order, said Mr. Taggart, which was issued nine years after the expiration of the franchise granted by the United States and twenty-two years after the date of the original decree by Spain, specifically mentioned both concessions, and that there was no misunderstanding of the periods—that for the American concession being fourteen years and for the Spanish forty years.

THE ISOLATED PLANT OF THE NEW BOSTON RAILWAY TERMINAL.

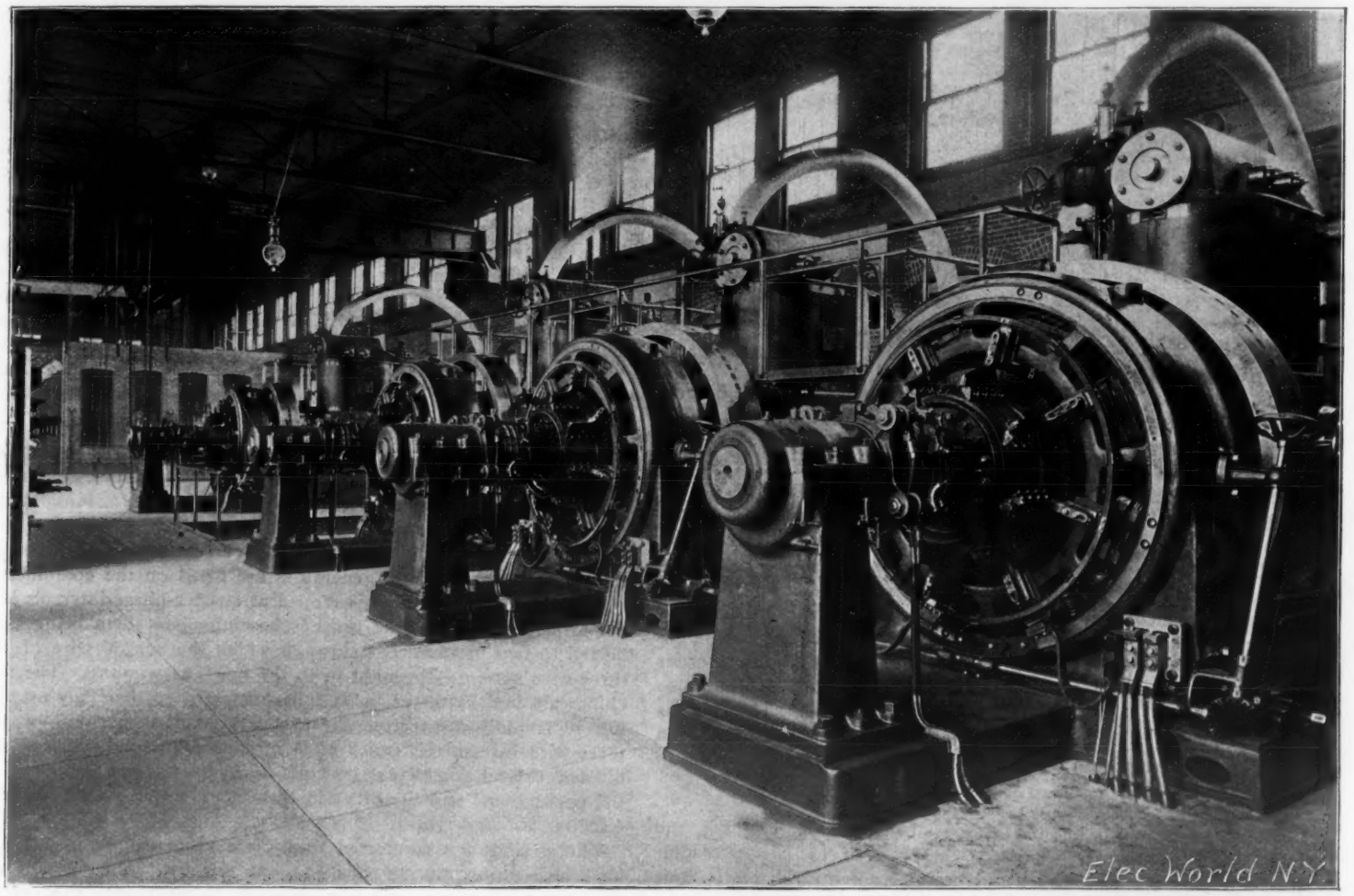
BY H. W. WELLER, C. E., E. E.

RAILROADS consist to-day chiefly of tracks, cars, steam locomotives, depots and terminal stations. Without permanent way and rolling stock a road could not well exist, but it has often been assumed that decent accommodations at the ends of the line were unnecessary. In Europe this is not so, for one will frequently find a poor railroad system terminating in a handsome depot, of which a florid hotel constitutes no small portion. Americans have hitherto preferred to keep their Waldorfs and Grand Centrals apart, but out of the growing volume of travel, the increased artistic taste and the diffused love of comfort have sprung lately several union depots or terminal stations that mark in railroading the distributive age as distinguished from the receiver's; for only with large resources and as part of well-managed properties could these magnificent clearing houses of travel have been created. Foremost among the newest of these, and perhaps in every respect of magnitude and perfection an easy leader, is the South Station of the Boston Terminal Company, which we are enabled to illustrate and describe in this issue. A station of this character is so complex in its functions we cannot deal with them all, but such as fall within the province of electricity present many features of great interest.

When the general design and lay-out of this magnificent railway station had been decided on one of the most important problems that confronted the management and their engineers was the question of the power plant for the necessary heat, light and ventilation, the operation of elevators, the supply of hot and cold water, making of ice, pumping, etc., and last, but not least, the compressed air and electric current necessary to operate the extensive system of electro-pneumatic switching and signaling. After much careful thought and consideration on their part, the whole plan was suggested by and a comprehensive contract made with the well-known engineers, Messrs. Westinghouse, Church, Kerr & Co., to supply and install the whole of the necessary apparatus.

In designing the plant many unusual and difficult conditions were encountered, and the manner in which the various problems were solved and the results attained reflect great credit on the chief engineer of the terminal company, the contracting engineers, and their representative in direct charge of the work.

The power buildings are located on the east side of the yard, on



VIEW OF MAIN GENERATING UNITS, AND TRAVELING CRANE.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

the line of Dorchester Avenue, and are constructed of selected hard-burned red brick, with cut granite sills and trimmings, the roof being carried on iron trusses.

The power house is 460 feet long by 40 feet wide, the shape being determined by the desire to encroach on the width of the yard and track room as little as possible.

The machinery is laid out in what may be termed "tandem" fashion, beginning at the northern end, with the ice and refrigerating plant, the ammonia and air compressors coming next, the engine and dynamo room next, en suite, with the stack, economizers, central heating plant and the boiler room, while beyond all, to the south, is the Pintsch gas plant.

Boiler Room.

The boiler room is lofty and well lighted, and contains at present ten horizontal return tubular boilers, with a sufficient space left for five additional boilers when necessary. The boilers are built of best open-hearth steel, and designed for a working steam pressure of 150 pounds to the square inch. Each boiler is 72 inches in diameter and 18 feet long, and contains 130 best charcoal iron tubes 3 inches in diameter and 18 feet long. They were built by Messrs. Edward Kendall & Sons, of Cambridgeport, in conformity with the most rigid specifications. They are set in one battery, and are equipped with the well-known Roney mechanical stokers, which insure economy, even with a poor grade of fuel, and also prevent smoke.

The stokers are operated by two standard Westinghouse engines, with cylinders 4½ inches in diameter and 4 inches stroke. One engine is placed at each end of the battery, and as the main shafts of the stokers are coupled together either engine can operate all the stokers.

The brick setting is carefully designed, selected hard-burned red brick being used, with first quality fire-brick lining, and a large combustion chamber is provided with a deflecting arch of fire-brick. The boilers are supplied with the usual gauges, water columns, etc., of the Star Brass Company manufacture. The feed piping is of extra heavy brass, and is brought to the fronts of the boilers, entering them by means of a "spray" pipe just below the water line. The blow-off piping is carried in a trench in the alleyway in the rear of the boilers, and each boiler is connected with it by two valves placed in series, one being an asbestos-packed plug-cock and the other a Chapman guard gate valve. The blow-off is carried up into a suitably vented blow-off tank and then discharged by gravity into the harbor.

The waste gases are passed into a substantial square iron flue carried over the fronts of the boilers to a pair of economizers next the stack, and is provided with the necessary cleaning doors, etc., and covered with 1 inch of fire-felt and then a covering of plastic asbestos non-conducting material supplied by the H. W. Johns Company, of New York. The economizers, which are of the Westinghouse improved circulating pattern, and manufactured by the Fuel Economizer Company, of Matteawan, N. Y., consist of two portions, one containing fifty-two sections and the other twenty-four sections, or a total heating surface of 7600 square feet, and having the usual scrapers operated from the shafts of the draft fans. Proper dampers and a by-pass flue are provided, so that either or both of the economizers can be cut out at any time and the gases passed directly into the stack; or the economizers can be operated in series.

The gases pass from the economizers to the exhaust fans and thence to the stack.

The draft is induced by two special blast wheels, 14 feet in diameter by 7 feet wide, designed by Westinghouse, Church, Kerr & Co. and built to their detail original specifications by the B. F. Sturtevant Company. They are overhung with three-quarter housing, and are direct connected to two horizontal centre-crank engines, with cylinders 12 inches by 14 inches stroke, and either unit is capable of operating the plant. The induced draft was chosen in order to make possible the greatest saving from the economizers, and also because the draft is under better control at all times. The stack is of steel plate ⅜ inches thick and 11 feet in diameter, supported on a framework of structural iron, and reaches just through the roof of the building.

Steam Piping.

The steam piping is one of the special features of the plant, and is arranged in duplicate, so that in the event of temporary trouble with any part the service will not be interrupted; and this is done without the usual complication. It was laid out with much care, and built and fitted accurately to drawings furnished at the shops of the National Tube Works, at McKeesport, Pa. It is lap-welded of heavy steel, with heavy wrought-steel flanges welded on, and on arrival in Boston was put together in place without any change being necessary. Bends are liberally used. The main steam pipe is 12 inches in diameter and covered with H. W. Johns Company sectional asbestos fire-felt covering, neatly finished off with polished brass bands. The pipe is hung from the roof trusses by swinging iron rods, leaving it free to expand without strain. Two main lines of piping are provided, one above the other, the ends in the boiler room being connected by a "U" bend of copper. Both mains are carried overhead in the rear of the boilers, the upper one dropping down, with bends, into the basement of the engine room, and running along the east side of the engine foundations to the north end of the basement. The lower line turns to the left toward the stack, drops down and runs along the west side of the engine foundations. At the north end of the basement the two pipes curve round and are connected together, forming a complete loop, and provided with the necessary valves to cut it into sections if required. A 6-inch auxiliary pipe connects across these two mains in the fan room, and from this auxiliary is taken the live steam for the central heating plant, the pumps and fan engines. Suitable iron galleries and stairways run alongside the main steam pipes to facilitate the handling of the valves.

The boilers are connected with each of these steam mains, a 6-inch steel bend carrying the steam from the front nozzle of each boiler to the upper steam main, and a 5-inch bend to the lower main. The steam valves are heavy duty, with outside screw and yoke, and are provided with a by-pass. Iron pipes for fire protection are carried through the buildings, and furnished with the necessary valves, and iron racks containing the flexible hose and fire nozzles.

The coal is brought to the plant in standard-gauge coal cars, run on standard tracks, carried on iron columns and girders directly over the coal bins in front of the boilers, into which bins the coal is dumped through hatchways. From these bins the coal is at present shoveled by hand into the hoppers of the stokers. The feed water is supplied to the boilers by two Worthington compound duplex steam pumps, with cylinders 9 inches and 14 inches steam, and two 7½ inches water by 10 inches stroke, either pump being capable of supplying the boilers. There is also installed a 2000-hp "National" feed-water heater, located overhead by the side of the stack and adjacent to the economizers.

The Engine Room.

The engine room is lofty and well lighted by two rows of windows on each side, and has two large double doors on the west side. The floor is of granolithic concrete, and an opening, protected by heavy polished brass railings, is provided over the condensers, with an iron stairway leading to the basement. This leaves the condensers in full view from the engine-room floor, and easy of access. All the engine valves are mounted on iron standards and controlled by hand wheels from the engine-room floor. A traveling crane of 40,000 pounds capacity travels the entire length of the engine and compressor rooms. It is carried on girder tracks, supported on brick piers built out from the side walls, with heavy stone bearing caps. It was supplied by the Whiting Foundry Equipment Company, of Chicago, Ill.

Engines and Generators.

Installed in the engine room are four similar units, each consisting of a 375-hp Westinghouse compound engine, with cylinders 18 inches and 30 inches in diameter by 16 inches stroke, running at 250 r. p. m., with steam at 125 pounds per square inch. Each engine is coupled to a Westinghouse 8-pole direct-current 220-volt compound-wound generator. These generators are fitted on the commutator end with four collector rings tapped at quarter-phase intervals into the armature winding, the brushes bearing upon them being connected to two balance coils through which the neutral wire of the three-wire system is brought in to the machine winding. The machines are built with the fields split vertically, so that they may be moved laterally away from the armature, and on account of the three-wire feature the series coils of the compound winding are divided, there being two series coils on each pole, one connected in the positive end and the other in the negative end of the machine circuits.

The engines are connected to the steam mains by bends, and an 8-inch pipe connects each to the exhaust. The engines are run non-condensing, and the exhaust is taken into the central heating plant for general purposes, but otherwise they are run condensing. Proper iron platforms and stairways are con-

structed round the engines to facilitate the work of the attendants, the platforms of the three engines nearest the boiler room being connected together for convenience. Space is provided for two more similar units if the additional power is required in the future.

A handsome gauge-board of polished white marble, supported on iron standards, is placed on the east side of the engine room, containing five polished brass gauges, showing, respectively, the boiler pressure, air-interlocking, vacuum, back pressure, and air-brake testing pressure.

In the basement of the engine room are installed the four balance coils for the generators and also the condenser. This is a jet condenser and pump made by the Deane Steam Pump Company, of Holyoke, Mass., with cylinders 18 inches and 28 inches by 24-inch stroke. The exhaust from the engines is brought to it by a 16-inch steel main on the west side of the basement, the main exhaust passing to the central heating plant through an 18-inch steel pipe. Arrangement is made for a free exhaust into the atmosphere if necessary. Salt water is pumped from Boston Harbor, which the station flanks, for use in the condenser, the inlet pipe or suction being suitably protected from the entrance of rubbish or foreign matter.

A Deane pump 8 inches and 7½ inches by 6-inch stroke is also placed in the basement for pumping salt water from the harbor for cooling the compressed ammonia before it is expanded for cooling purposes. A system of Westinghouse steam loops is provided, which enables all the clean water from live steam drips and separators to be returned automatically to the boilers without the use of any moving mechanism. The heating of cars waiting in the train shed in cold weather, when the locomotive is detached, is provided for by a complete system of steam mains leading to the ends of the stub tracks, steam at boiler pressure being passed through a reducing valve made by the Foster Engineering Company, of Newark, N. J., supplying the mains with steam at 90 pounds pressure.

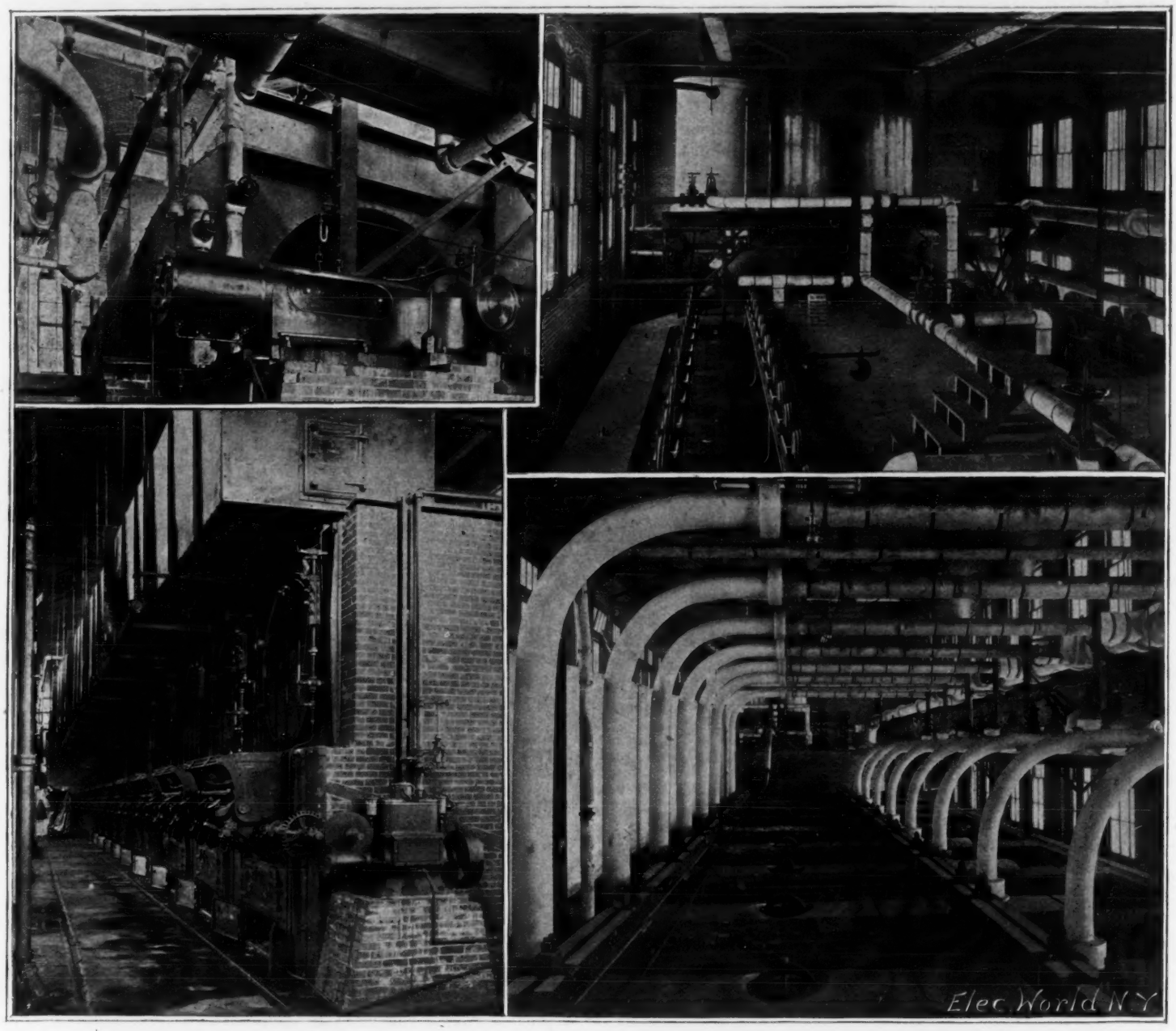
The Switchboard.

The switchboard for the electrical instruments is of polished white marble securely bolted to an iron framework on the west side of the engine room. It consists of thirteen panels. The station panel has mounted upon it two Weston standard voltmeters with illuminated dials, showing the e. m. f. on the two sets of bus bars. One Weston station voltmeter with an illuminated dial is carried on a swinging bracket, and can be thrown on any generator by the use of a plug switch. There is also a circular-pattern Weston ammeter, showing the unbalanced load on the neutral or balance wire of the system. A set of annunciators is installed, connected with the various centres of distribution for the lights, showing which centre is calling for current.

There are four pairs of machine panels, one for each generator, one of each pair being connected to either side of the system. The positive contains the field rheostat, a circular Weston ammeter, a

Blower for Induced Draft.

Top of Economizer.



Fronts of Boilers, Showing Part of Stoking Mechanism.

Tops of Boilers, Showing Piping.

DETAILS OF BOILER PLANT.

magnetic cut-out switch or circuit breaker, which opens the positive line and also the positive equalizer; also a main switch, controlling both the positive and negative side of the machine, and the positive and negative equalizer. This switch is double-throw, and can connect the machine to either set of bus bars. The two sets of bus bars are provided in order that two different potentials can be carried at the same time, and so that machines can be run in multiple or separately on different services. On the negative panel of each pair is another magnetic circuit breaker, which opens the negative side of the line and the negative equalizer. There are also four feeder panels containing the various double-throw pole switches for throwing each feeder circuit to either of the two sets of bus bars. These panels also contain the various circular-pattern voltmeters operated by pressure wires from the several centres of distribution, showing the power-house attendant at all times the actual e. m. f. at the various distribution boards.

A polished white marble gauge-board is installed in the office of the superintendent of the power plant, containing five Bristol recording gauges for the steam, compressed air for interlocking, compressed air for air-brake testing, e. m. f. on the high-potential, and the e. m. f. on the low-potential bus bars.

Feeder System.

There are sixteen two-wire feeders on the 220-volt circuits, running from the main switchboard at the power house, twelve of these leading to the various centres of distribution, and used for lighting purposes only, and the other four sets of feeders being for motor service. There is also the balance or neutral wire of 400,000 c. m., running from the balance coils in the basement, making a complete loop around the station buildings, and taking in all the centres of distribution. The arc and incandescent lamps are connected across from either wire of the 220-volt feeders to the balance or neutral wire, giving them an e. m. f. of 110 volts.

The twelve lighting circuits are divided as follows: No. 1, the public incandescent lights, such as waiting rooms, lavatories, etc.; No. 2, the basement lights, fan rooms, cellars, etc.; No. 3, the restaurants and other tenants; No. 4, the inward baggage rooms; No. 5, the outward baggage rooms; No. 6, public arc lights, including the train shed; No. 7, suburban platforms in subway; No. 8, office lighting; No. 9, suburban tunnels, both incoming and outgoing; No. 10, the express companies' buildings; No. 11, power house, gas plant, etc.; No. 12, interlocking towers and sump lighting.

At the above centres of distribution are located slate switchboards, provided with the necessary triple-pole switches, which control the various lighting circuits of that centre. A pilot lamp indicates the presence of the current, and a push button signals to the power house when current is required.

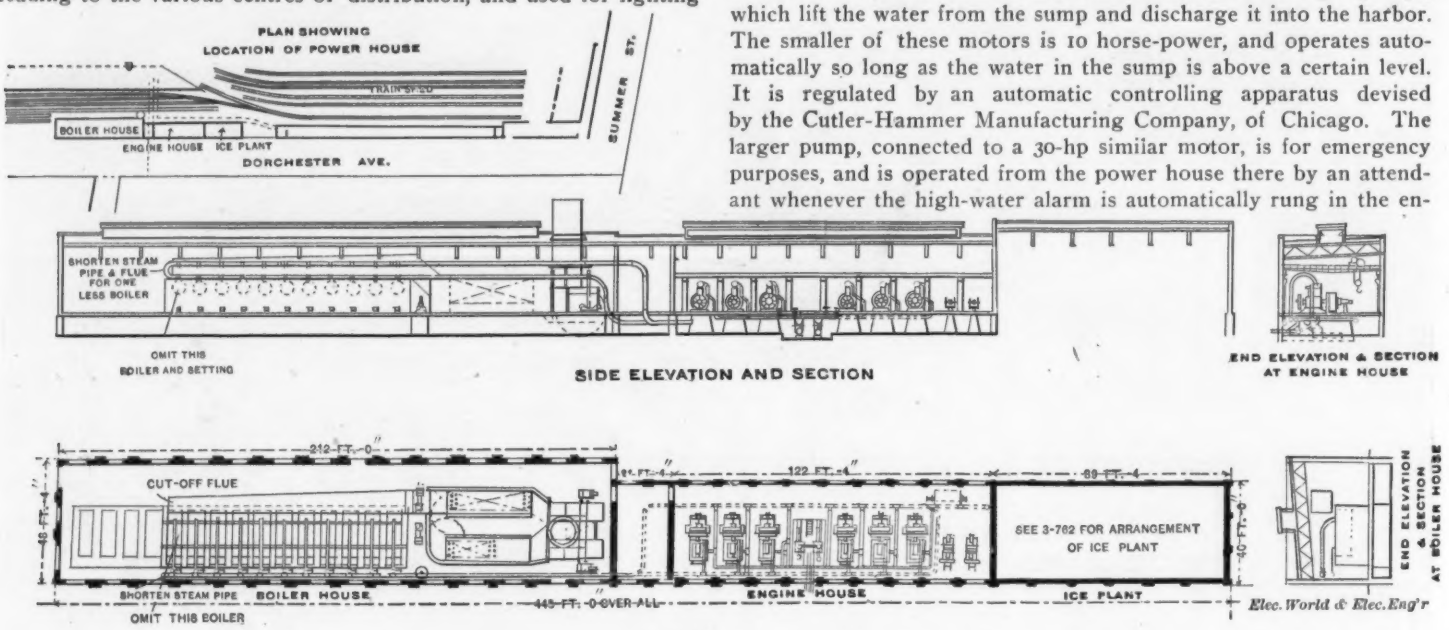
There are between 6000 and 7000 110-volt incandescent lamps installed. They are Sawyer-Man high-efficiency 3.1-watt lamps, and have a regulation within 2 per cent. There are also upwards of 250 enclosed long-burning arc lamps, supplied by the Jandus Electric Company, which consume about 5 amperes at 110 volts. These are used for lighting the train shed, baggage rooms, entrance, and for lighting outside the station under the sidewalk awnings.

The motors are fed from the 220-volt circuit, and the following distribution of the circuits has been arranged: One operating all the elevators and baggage lifts, except the elevator for the ice plant; one operating the basement fan motors for warm-air heating; another for the ventilating motors and attic fans; and the remaining one for the sump motors and the ice plant.

The various feeders are carried along the roof and sides of the tunnels used for the heating mains, and along the basements of the baggage and waiting rooms, being supported on porcelain insulators, and suitable racks where necessary. The main waiting room is lighted in a very pleasing and artistic manner, harmonizing with the architectural features. There are thirty-three fifteen-light clusters enclosed in opalescent globes, at the intersections of the deep ceiling beams, and forty-eight ten-light clusters, besides 228 side bracket lights, or over 1200 lights in this waiting room. The fixtures throughout are specially designed and very handsome, those in the grand dining room being of bronze.

Pumping.

All the waste and drainage water from the lower levels and inclines is carried by a system of drains to a large sump located near the power house. In the pump house over the sump are installed two specially designed vertical waterproof, slow-speed Westinghouse motors, direct connected to two vertical centrifugal pumps, which lift the water from the sump and discharge it into the harbor. The smaller of these motors is 10 horse-power, and operates automatically so long as the water in the sump is above a certain level. It is regulated by an automatic controlling apparatus devised by the Cutler-Hammer Manufacturing Company, of Chicago. The larger pump, connected to a 30-hp similar motor, is for emergency purposes, and is operated from the power house there by an attendant whenever the high-water alarm is automatically rung in the engine room. The pumps were made by the Lawrence Machine Company, of Lawrence, Mass.



PLAN, ELEVATION AND SECTIONS OF POWER HOUSE.

Air Compressors.

At the northerly end of the engine room are installed two Ingersoll-Sergeant Drill Company air compressors, with 12-inch steam and 10-inch air cylinders by 24-inch stroke. These are duplicates, and one of them keeps a constant pressure of 100 pounds on the pneumatic signaling and interlocking system. An automatic relief valve cuts off the steam, except enough to keep the engine running, when the gauge pressure rises to 100 pounds, the air valves being also automatically controlled. When the pressure is lowered the compressor starts up again.

Two large-size 9½-inch Westinghouse air-compressor pumps are provided and connected with a compressed-air system for testing air brakes in the train shed.

Heating and Ventilating.

A positive hot-water circulating system from a central heating plant in the power house provides a very satisfactory medium for absorbing the heat from exhaust steam when available, and at other times from live steam, and supplying it for warming long ranges of buildings located a considerable distance away from the source of heat. The circulating water is heated in three large vertical tubular heaters, two of which are for use when exhaust steam is available and the third when live steam is necessary for heating, or for reheating when the weather is exceptionally cold, and the exhaust steam is insufficient to produce the necessary temperature. A re-

lief or pressure tank is located in the head house near the roof to keep a constant pressure on the hot-water system, and is supplied with a ball valve, which keeps the mains full of water by replacing the waste.

In order to pump satisfactorily hot water at 60 pounds pressure, a special design of pump was necessary. To meet the conditions two centrifugal pumps were built by the Lawrence Machine Company. These are direct connected to two Westinghouse standard engines with cylinders 8½-inch diameter and 8-inch stroke. Either one of these units pumps the hot water from the heaters and forces it through the mains to all parts of the station buildings, the main loop being five-eighths of a mile long, and as the circulation is rapid and continuous the various buildings are easily and uniformly supplied with heat. Long, easy bends are provided in the mains throughout, to reduce the frictional resistance. The main corridors in the head house are heated by direct radiation, but the offices, waiting rooms, etc., are heated by indirect. Heaters are located in the various basements through which the hot water from the central heating plant is passed, and the pure, fresh, external air is forced through these heaters by means of blower fans or blast wheels, belt-driven by electric motors. This provides what is called tempered air, and some of this is passed through a secondary heater or re-heater, raising the temperature as required. These two kinds of air are taken through separate systems of ducts to the various rooms, where the air can be mixed to suit the requirements of each particular room. There are six of these blower fans in different portions of the basements, operated by six standard Westinghouse multipolar motors, ranging from 5 to 30 horse-power each. Suitable controlling instruments are mounted on a neat gauge-board adjacent to each motor. Eleven special slow-speed vertical motors, varying from 1 to 8 horse-power, direct connected to the same number of attic fans in the roof, insure perfect ventilation, as all the vitiated air is drawn up by them and discharged into the atmosphere outside. Owing to the great distances which the hot air had to be carried many of the hot-air flues have been covered with insulating material, as was done with all the hot-water mains.

A supply of hot water for general purposes throughout the building is provided by a number of storage heaters, in which water taken from the city mains is heated by live steam. The temperature is controlled by an ingenious thermostat supplied by the Davis & Rosch Temperature Controlling Company of Chicago, and circulation takes place by gravity through an extensive system of piping.

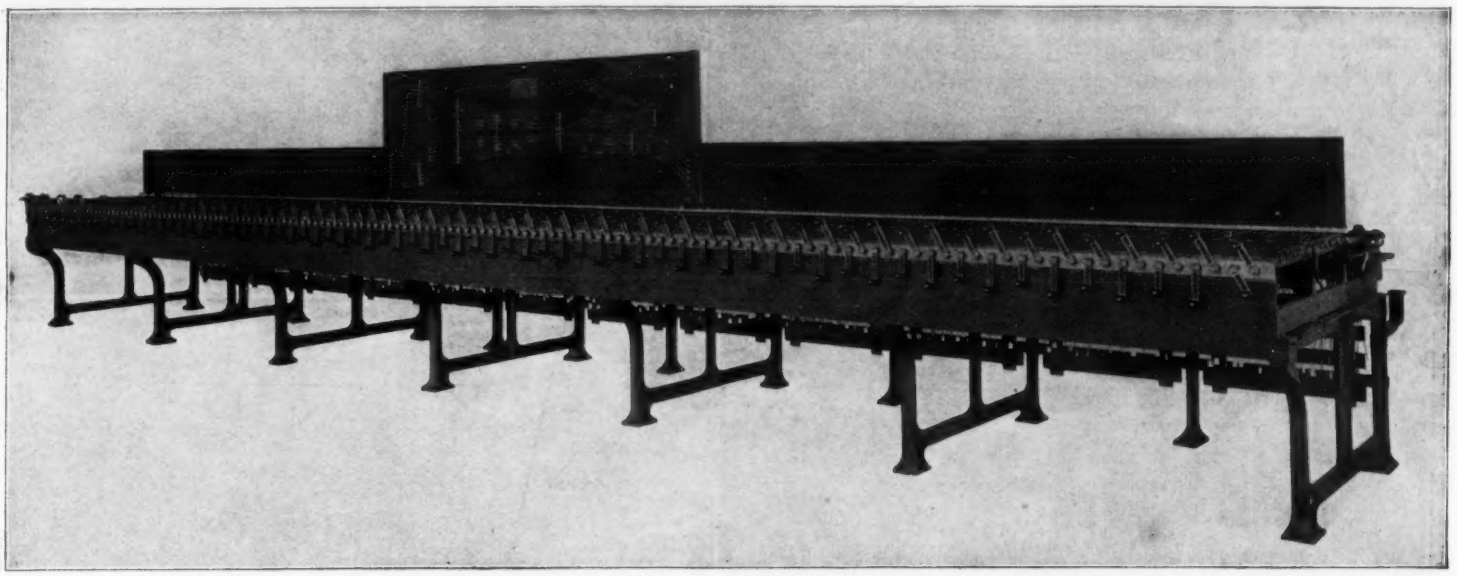
The Ice and Refrigerating Plant.

A most complete ice and refrigerating plant has been installed, furnishing cool water for drinking purposes direct from the city supply, cooled to the proper temperature and circulated to the various drinking fountains throughout the buildings, thus avoiding the use of numerous ice-water tanks, difficult to keep clean and sweet. It also provides cold storage and refrigeration for the restaurant larder, and, lastly, manufactures all the ice necessary for use in the cars and for other purposes.

There are two special ammonia compressors, designed by Westinghouse, Church, Kerr & Co., direct connected to two special Corliss engines, made by Messrs. Hewes & Phillips, of Newark, N. J., in accordance with the contracting engineers' specifications, The large one has a steam cylinder 20 inches in diameter and an ammonia cylinder 16-inch by 32-inch stroke. The smaller one has a 14-inch stream and 10½-inch ammonia by 20-inch stroke. The ammonia cylinders have four valves in each head, two inlet and two outlet. The compressed ammonia is passed through the a large ammonia condenser, over which trickles cold salt water, absorbing the heat of compression from the gas.

The water for the manufacture of ice is taken from the city mains and passed through a filter into the tanks, where 20 tons of "Diamond" ice can be made each day on the plate system. The water in the tanks is constantly circulated by a Deane steam pump, and passed through a circulating filter, covered with insulating material, in which is maintained a slight vacuum. This not only removes impurities but the air contained in the water, allowing the ice to form without objectionable air bubbles. The necessary pumps and brine tanks are also provided for restaurant and cooling purposes.

An electric elevator of the Morse belted pattern, operated by a Westinghouse multipolar motor, is used to take the ice from the tank room to the ice house below. A steam harvester, or ice cutter, is provided to cut the ice into suitable blocks, and an overhead traveler, with pneumatic hoist, conveys the blocks of ice to the elevator.



FRONT OF INTERLOCKING MACHINE.

Electric Passenger Elevators and Baggage Lifts.

This part of the plant consists of seven passenger and twelve baggage elevators, besides one small freight elevator for conveying the ice from the ice plant to the storehouse below. All of these, with the exception of the last mentioned, were furnished and installed by the Sprague Electric Company of New York.

All the passenger elevators are located in the head house, and serve the general offices, restaurants, etc. Four of these are of the well-known type "Z" machines, with a car rise of 70 to 80 feet. Their individual capacity is 4000 pounds, at a speed of 200 feet per minute, but, with an average load, about 250 feet per minute. These four machines are of the tandem worm-gear construction. The worm-wheels are of bronze, cut with a double lead "Hindley" tooth, giving a greater bearing surface and a higher efficiency than the ordinary tooth. The two steel worms are cut with a right and left hand lead respectively, so that the whole of the end thrust is taken upon the gear teeth. Two steel spur gears, meshing together, are mounted upon either side of the same spider as each bronze gear, thus providing an interlocking arrangement between each worm and wheel gear.

The motors, which are rated at 20 horse-power, at a speed of 470 revolutions per minute, are readily capable of 50 horse-power for a short time. By means of field changes their speed can be varied from 470 to 900 revolutions per minute without sparking.

Each motor is shunt wound with four poles, the fields being cast in one piece, except the two poles, which carry the coils. The armature, which is of the two-path series drum winding, with the coils formed and laid in the slotted core, is mounted directly on the worm shaft. The drums are 36 inches in diameter, and the machines are fitted with the regular electric brake of the Sprague type, the brake pulley being mounted on the armature shaft. The brake shoes are held away from the pulley by the brake magnet while the machine is in operation, but are released and the brake set mechanically whenever the current is shut off, either by the controller or in case of accident. There is also a centrifugal governor belted to the armature shaft, so that should the machine exceed a predetermined speed, the circuit is opened, and the controller is brought to the normal stop position, and the brake applied.

The worm gears of these machines are run in oil, and the bearings of the drum and worm-shafts are large and self-oiling.

The controllers are of the standard pilot motor type, the details of which are too well known to be described here; the pilot motor, controlled by the push buttons in the car, operating the lever arm of the rheostat and the automatic switches.

The two magnet switches on the lower panel of the control make and break the circuit, reverse the motor, and short-circuit the motor through a resistance when stopping and when at rest. The stopping of the car and machine in ordinary operation is accomplished by the dynamic action of the short-circuit armature, the brake being applied only when the machine has almost come to rest. In emergencies the brake can be instantly applied.

The pilot motor is about one-sixth horse-power, series wound, and arranged to be thrown directly across the line in starting. The starting rheostats are of special design, easy of adjustment and repair, and absolutely fireproof.

Auxiliary carbon contacts, or arc arresters, are provided in all places where the main current is broken on the copper contacts. Several special safety devices are also installed, one of the most interesting being the "throttle." This is a magnet, the coil of which is a part of the main circuit. In starting, when the current exceeds that for which the "throttle" is adjusted, the plunger is drawn up, closing a shunt around the armature of the pilot motor, slowing down or stopping it altogether, and, with it, the rheostat arm, until the counter e. m. f. of the main motor has increased sufficiently to reduce the main current below the predetermined amount.

The next two elevators are of type "V," with a capacity of 2000 pounds each at a speed of 100 feet per minute, the car rise being 11 feet and 32 feet respectively. Each of these machines is operated by a two-pole motor rated as 6 horse-power at 850 revolutions per minute. They have each a single worm, the worm-wheel being of bronze and the worm of steel.

The drums are 30 inches in diameter, and the brakes are placed between the motor and the gear. The thrust of the worm-shaft is taken upon a ball thrust bearing outside the gear case. This bearing is in two parts, one for the thrust in each direction. In each portion are fifty half-inch steel balls, contained in a bronze carrier plate, and held between two steel plates, one bearing against a heavy steel nut on the shaft, and the other against the frame of the machine. The control for these machines is operated by a direct-acting solenoid, instead of a pilot motor, the movement of the solenoid being checked and regulated by an air dash pot, with a suitable adjustable air vent.

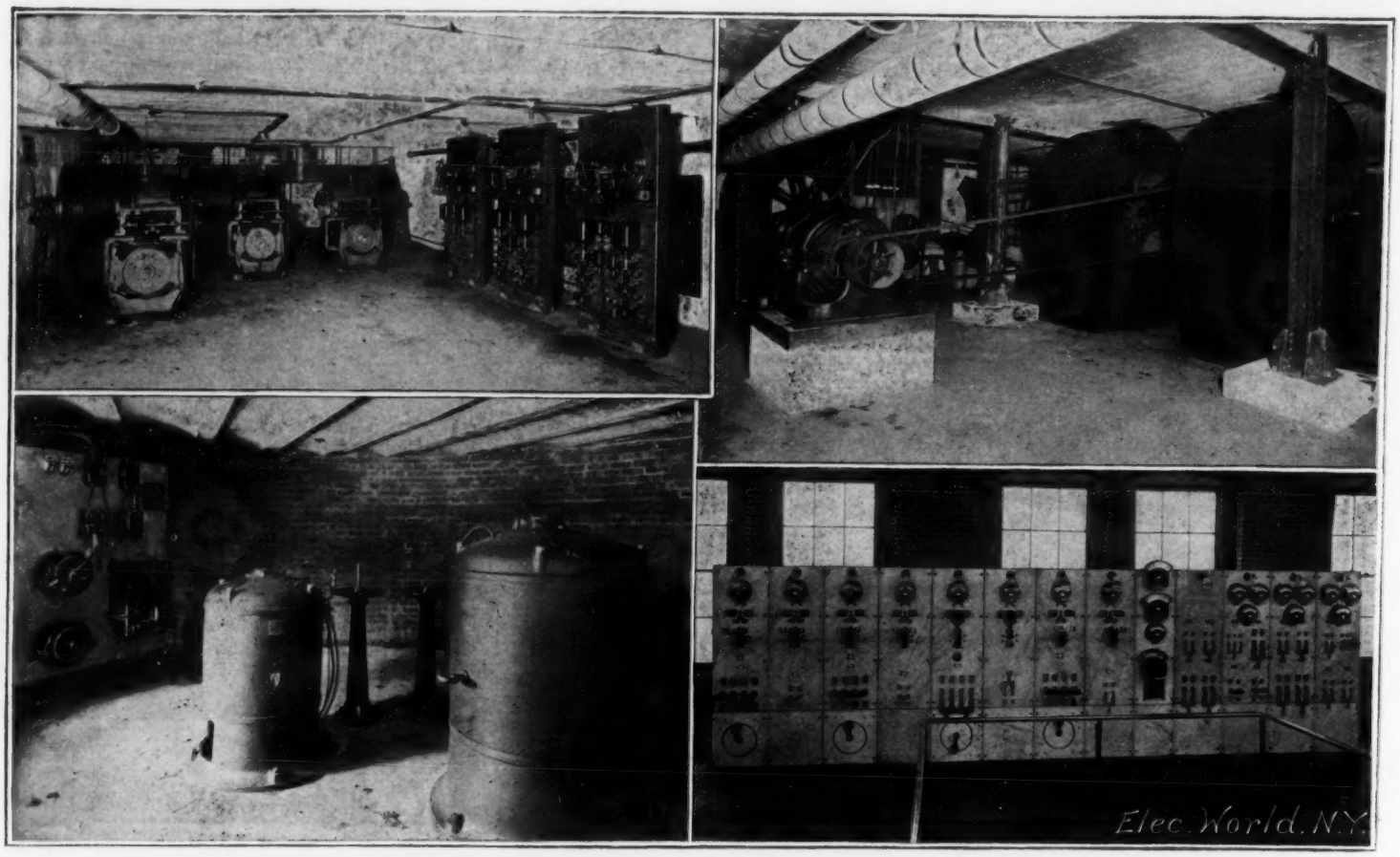
The remaining passenger elevator is of type "Q," with a car rise of 18 feet and a capacity of 2500 pounds, at 150 feet per minute. This is similar in construction to the type "V" machines, except that the motor is four pole, rated at 12 horse-power at 800 revolutions per minute.

All the above elevator machines are provided with "limit" switches, geared to the drums, which cut off all current from the motors at top and bottom of travel. There is also fitted to each car the special wedge type of safety, actuated by heavy steel spiral springs under compression, and connected to steel wedges on either side. The ropes on all the elevators are of steel with flattened strands.

The twelve baggage elevators or lifts, with an average car rise of 16½ feet and a capacity of 3000 pounds at 15 feet per minute, are operated by type "P" machines. These were specially designed for the duty required and the limited space available. They are placed in pockets or pans built of steel plates, formed in the top plat-

Sprague Elevator Machines and Controlling Mechanism.

Fan Chamber.



Vertical Motors and Switchboard.

Main Switchboard.

ELEVATOR, FAN AND DRAINAGE PLANTS, AND MAIN SWITCHBOARD.

form level, and just large enough to receive the hoisting machines and drums. These are built up on 12-inch channel irons framed into the platform structure at one of the short ends of the well. The motor used is rated at 12 horse-power at 750 revolutions per minute, and is similar to that of the "Q" machine. Steel worms on either end of the motor shaft mesh into bronze gear wheels. The shafts of the worm wheels are direct connected by flanged couplings to the two drum shafts extending along either side of the well. On each shaft are two chain drums upon which are wound the chains fastened to each corner of the elevator platform. The worm wheels are cut right and left to take up all of the end thrust. The worms and worm wheels are run in oil, and all bearings are self-oiling. Automatic "limits" are geared to one of the gear shafts, and two foot pushes are provided at each end of the platform, one for the "up" motion, and the other for the "down."

At each gate at top and bottom are placed push buttons for bringing the car to that landing, providing it is not already in service, and the gates are all closed. Automatic locks and safety switches break the circuit, and prevent the movement of the car until everything is secure at the landing. The gates are also automatically locked, except when the car is at that landing, in which case they are automatically released.

The iron railing, or inclosure, at the top landing is provided with a gate at each end, and these gates are connected by an interlocking gear on the lower landing, by which the gates can be opened or closed from below, if the car is at the upper landing and the lock released. These baggage lifts can make 100 round trips per hour.

Of the above lifts, four are located in the baggage rooms on either side of the train shed, five between the train tracks at the outer end of the shed, and the other three between the tracks at the head house end of the train shed.

The Electro-Pneumatic Interlocking System.

This part of the plant is very interesting, and embodies many novel applications. When one considers the number of tracks in use in the yards of the new station, with a daily average of 750 trains, requiring at least 4000 train movements, changes which during the busiest portion of the day probably aggregate 400 train movements per hour, some idea can be formed of the importance of an absolutely perfect system of signaling and switching. Not only must the trains be guided promptly to their proper track, but they must be safely guarded while there, and brought out again sharply on time. In the system installed by the Union Switch & Signal Company for the South Station, these objects have been accomplished, and when entirely completed, this station will have the most perfect system of signaling, switching and interlocking in the world. It is hardly within the province of this article to go into the various details of this system, but inasmuch as electricity has been brought largely into play as an adjunct to the mechanical devices, a brief outline of the apparatus may not be out of place. Compressed air is primarily used to operate all the semaphore signals and also the various switches distributed through the yard. Instead of the familiar iron rods, cranks and heavy switch levers, usually installed, small electro-magnets, controlled by wires directly from the operating table or interlocking machine in the signal tower, operate the valves admitting compressed air into the cylinders, causing the movements of the pistons or plungers, which move the various signals and switches. The current for this work is supplied from the two outside wires of the 220-volt circuit by two feeders direct from the power house, the necessary lights being placed between the balance wire, previously described, and one of the above outside wires. The 220-volt current is taken to the basement of the main switch tower and passed through the terminals of a 220-volt motor generator, which averages a consumption of about 5 amperes, and gives an average output of 30 amperes at 25 volts. This current is passed through an automatic cut-out and a Weston ammeter to a double-pole switch, by which the current can be diverted either to charge the low potential storage batteries used for the track circuits controlling the cautionary signals, or to the batteries connected with the interlocking machine. The former of these batteries consists of duplicate sets of two cells each, with a double-pole switch to enable either set to be charged while the other set is in service. The e. m. f. of this battery is from 4 to 5 volts.

The other battery consists of duplicate sets of six cells each, with a similar double-pole switch, and is for operating the interlocking machine. The e. m. f. of this current is 12 to 15 volts.

The track circuit for the cautionary signals consists of two main-feed wires from the low potential battery in the signal tower, passing along the ends of the 28-stub tracks at the inner end of the train shed, from which taps or leads are taken to each rail of each track, with a resistance coil of 25 ohms in series in each tap and forming a closed circuit through the magnet of a relay placed near the outer or yard end of the track.

When a train is standing on any of these tracks its wheels and axles short circuit the relay, the armature of which drops and opens the circuit connected to an indicator in the switch tower, showing the operator that this particular track is occupied. At the same time the armature opens a similar circuit operating a secondary or cautionary signal which is visible to the engineer of an incoming train warning him also that the track is already occupied.

The signals and switches are operated as follows: As soon as the lever man, from his train orders and the condition of the tracks, decides upon the particular track on to which a train is to be run, he places all the switches or combinations of switches involved in the necessary positions by movements of the various switch levers, an operation which cannot be performed unless all the signal levers, which interlock the switches involved in the combination, are at the normal position. He then moves the signal lever controlling the signal arm governing the train movement over the switches of the combination, locking the switches and admitting air to the signal cylinder, which drops the signal to the "clear," but only after everything is set and locked in the correct position. If any circuit is damaged or a battery or the air give out, the signals go to danger and remain there. When the reverse movement is made the interlocking of the switches cannot be released until the signal has actually gone to "danger."

There are two switch towers to contain the interlocking machines. In tower No. 1 is located the larger machine operating seventy-two levers for fifty single switches, and thirty double-slip switches, with movable frogs and fifty-eight levers for ninety-one main-line semaphore signals, thirty-six distant and twenty-one dwarf semaphore signals, besides thirteen spare levers, or a total of 143 levers in the frame. This tower and machine control all the switches and signals on the tracks running into the main floor of the station, and also those for the power house and express yards. The No. 2 tower has six levers for four single and four double slip switches, four levers for eight dwarf semaphore signals and one spare lever, or a total of eleven levers in the frame. These control the suburban tracks entering the basement or subway floor.

On the top of each interlocking machine is mounted a vertical working model of all the switches and signals controlled by it; so that the leverman can at all times see the operation of the switches outside, as all their movements are duplicated automatically on the model. The semaphore signals are grouped and mounted on nine iron signal bridges in suitable locations, about 40 feet above the level of the tracks, the bridges varying from 50 feet to 137 feet in span.

The lights required for the signals are 150 in number, and, while at the present time oil is used, they will probably be lighted by electricity in the near future.

Mr. J. P. Coleman, of the Union Switch & Signal Company, has superintended the installation of the entire interlocking system, with its many complicated and difficult problems.

Gas Plant.

A complete gas plant for supplying compressed illuminating gas for the Pintsch system of car lighting has been installed in a separate brick building at the south end of the power house, together with a suitable gasholder adjoining. The gas is manufactured from oil, and the plant is capable of producing 120,000 cubic feet daily.

The equipments for the operation of the station as described in this article are far more complete than those provided for any other railroad station in the world. The various portions of the work are harmonized and related to each other to a degree that has resulted in a very large saving of apparatus, and a great gain in simplicity and efficiency of operation. This was only possible with the oversight and control of an organization experienced in each separate branch, and competent to undertake the work as a whole. To the continuous efforts of General Manager Sanborn, Chief Engineer Francis and Messrs. Westinghouse, Church, Kerr & Co. and their subordinates are due the results that place the power equipment of this station so far ahead of anything that has heretofore been attempted. The operation of the plant is in the hands of Mr. G. B. Celdwell, superintendent for Messrs. Westinghouse, Church, Kerr & Co., F. W. Hadley and W. W. Webb, assistant superintendents for the Terminal Company, and three chief engineers, F. W. Kimball, C. F. Carpenter and N. G. Young, taking charge of the various watches, while Mr. L. G. Hayden is electrician.

Water and Electric Power Plant Near Helena, Montana.

THE advantages of transmission in the use of mining and smelting are herewith shown by the results obtained since the plant of the Helena Water & Electric Power Company was put into operation. This plant, which was fully described and illustrated in "The Electrical Engineer," March 31, 1898, is situated at Canyon Ferry, on the Missouri River, 18½ miles from Helena, Mont. A timber dam was constructed, giving a 27-foot head. At one end of this dam a heavy stone embankment was built, shown in the two illustrations herewith, and within this structure the penstocks are imbedded, as shown in Fig. 1. The penstocks enter the power house at the side facing the cliffs, and in order to accomplish this very sharp turns had to be made.

The power house is a magnificent stone structure. At present it contains four 750-kw Westinghouse generators, which are direct-connected to wheels manufactured by the Dayton Globe Iron Works, of Dayton, Ohio. These machines operate at 157 r. p. m., and deliver 550 volts to the bus bars. The fields of these machines are excited by two 100-kw 120-volt d. c. generators, direct-connected to two smaller wheels of the same make as the above. The switchboard is of Italian marble, on the face of which are mounted the necessary switches and measuring instruments, together with synchronizing devices.

The transformer house is about 50 feet distant from the power house, and contains eight 300-kw step-up transformers. The initial voltage is here transformed to 10,000 volts. Current is transmitted to the various smelting and other plants by means of four circuits of No. 1 wire. The pole line is remarkably well constructed, and went through the late terrific weather without any hitch or interruption.

Situated 13 miles distant from the generating station is the plant of the Helena Smelting & Refining Company. Current is used for crushing, hoisting, etc.; in fact, wherever motors can be used to any advantage, the work is done by that means. In Montana, where labor is expensive and scarce, this item is a great factor in production. The blast for the smelters is furnished from two 36-inch air compressors, which are driven by two 175-hp type "C" Westinghouse induction motors. The sampling works, where all the grinding and crushing of ore preparatory to roasting is carried on, are operated by one 100-hp type "C" induction motor. It is remarkable

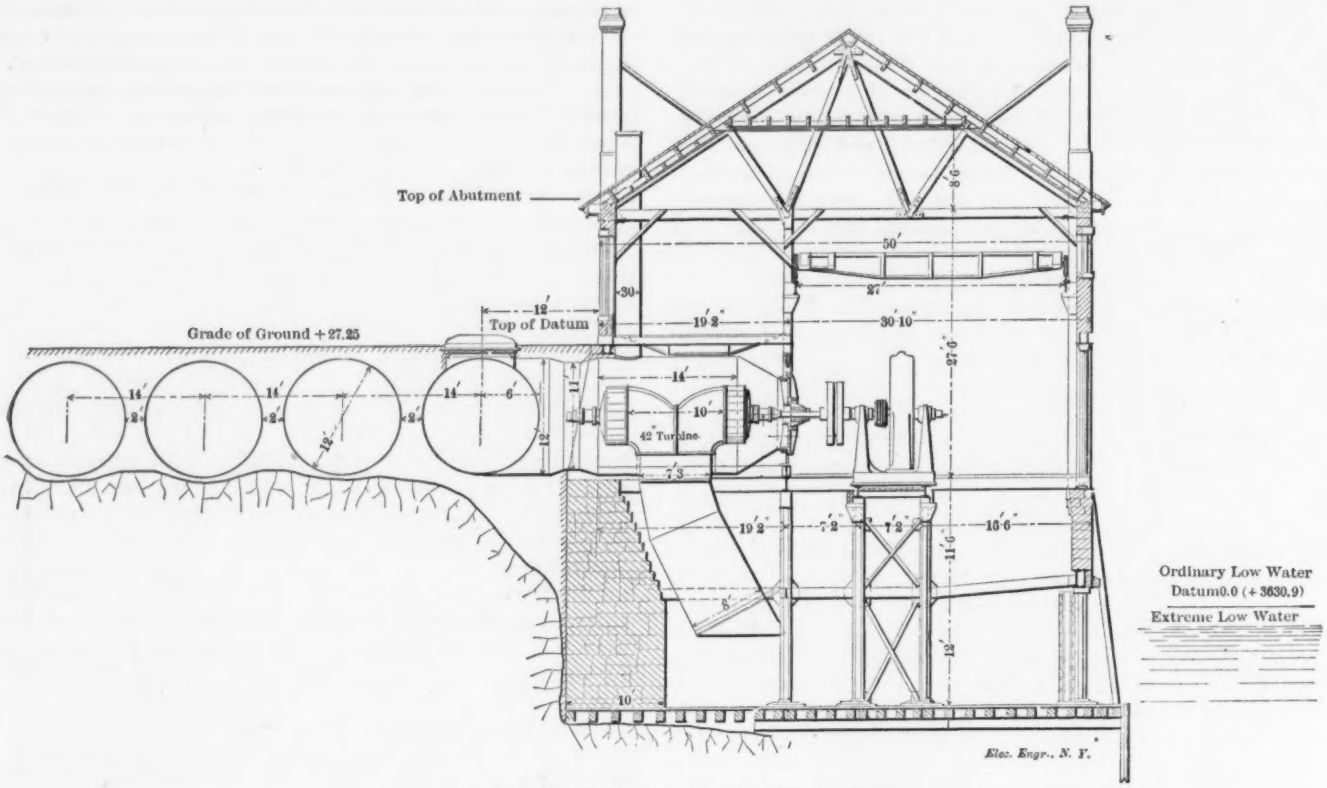


FIG. 1.—CROSS-SECTION OF POWER HOUSE.

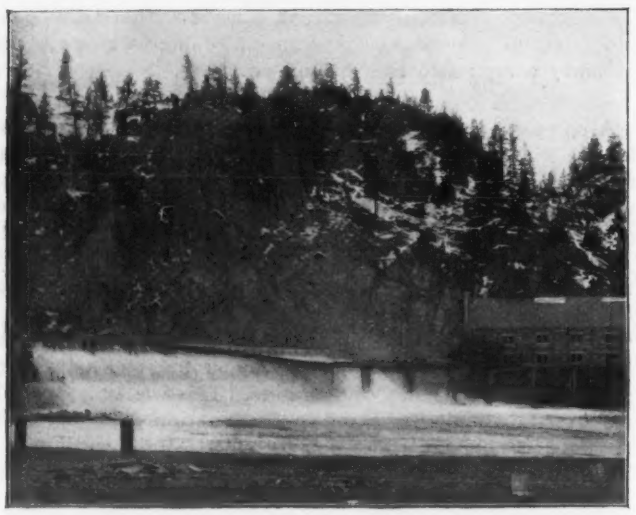


FIG. 2.—VIEW OF DAM.

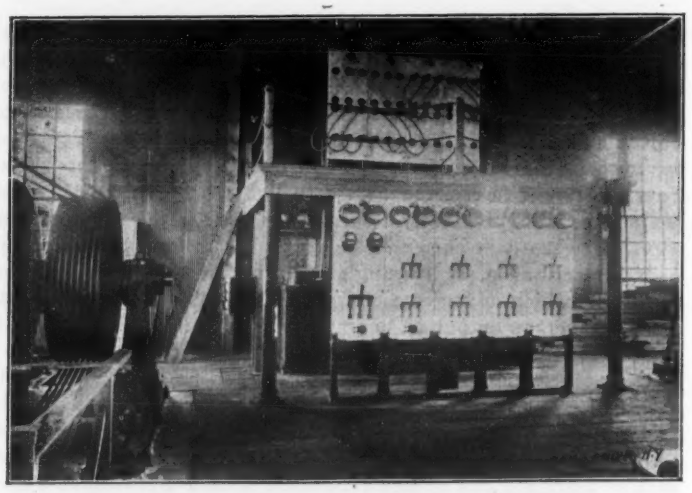


FIG. 3.—SWITCHBOARD IN SMELTING WORKS.

that this motor has been carrying a continuous overload of 225 horse-power since the plant was started, on the 6th of October last. In the pump house of these works are two direct-connected pumps for fire purposes, and to furnish water for general use, connected to one 100-hp and one 20-hp induction motor of the same make, respectively. These motors have already demonstrated their efficacy, as during a recent fire they deluged the building in a manner which was equally pleasing and surprising to the officials of the company. The machine shop and blacksmith shop are provided with one 20-hp motor each, to perform the various work necessary. The ore is hoisted to the crushers by one 50-hp motor, which also operates line shafting to hoist the ore to the smelter. In the roasting department the 20-hp motor is attached to a very ingenious contrivance which moves the ore from one section of the furnace to another while it is in the process of being roasted. This contrivance was designed by Mr. Hickson, the mechanical superintendent of the smelter. This motor relieves nine men from work which is very laborious, and in the summer time almost insufferable. The residence of the manager, and the various offices and sleeping apartments of the members of the staff, are lighted by this plant, and the heating of the buildings is also derived from the same source.

It is interesting to know that since the introduction of motor power for the air compressor on this plant, the number of heats on each twelve-hour shift has been increased from 45 to 64, which is very satisfactory to the directors of this plant.

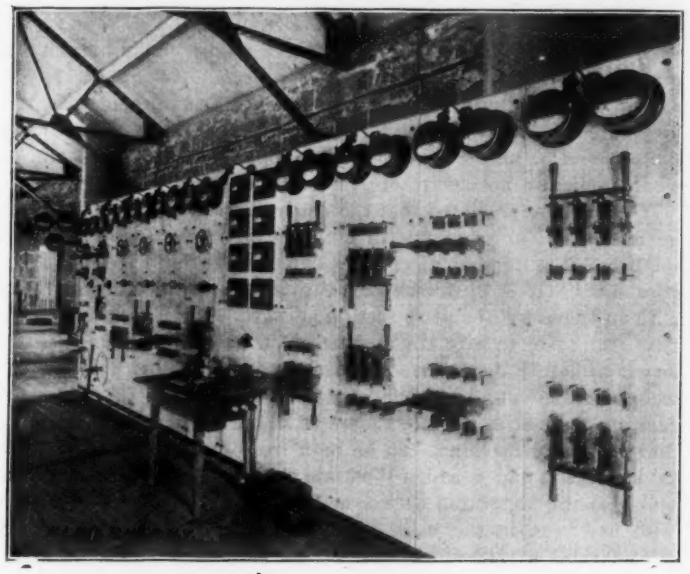


FIG. 4.—MAIN SWITCHBOARD.

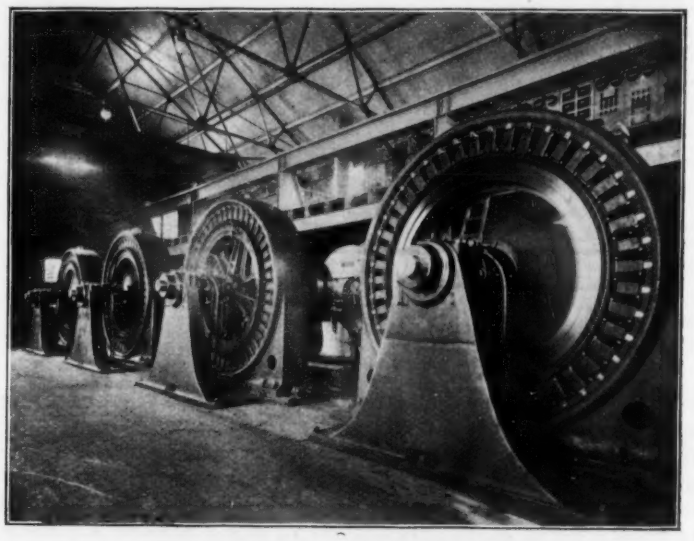


FIG. 5.—THE GENERATORS.

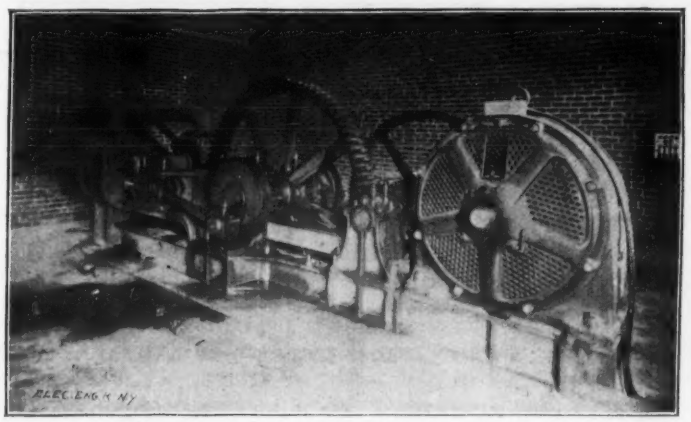


FIG. 6.—INDUCTION MOTOR DRIVING COMPRESSOR.

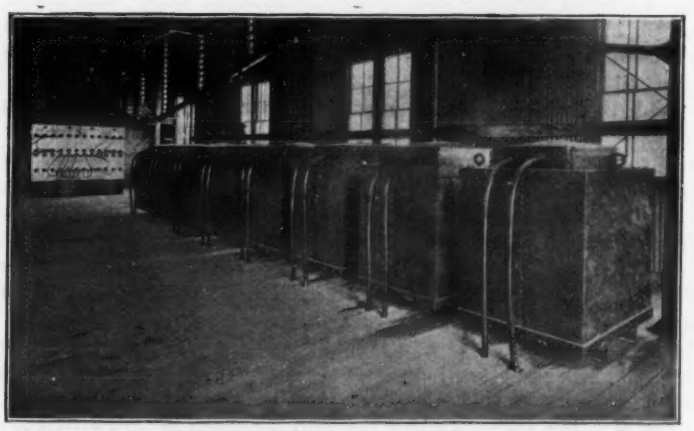


FIG. 7.—STEP-UP TRANSFORMERS.

Two miles northeast from this plant is situated the concentrator of the Helena & Livingstone Company. This plant is used to concentrate the ore preparatory to delivering to the smelter. Most of the machinery in the building was designed and is owned by the superintendent of the plant. It is sufficient to state that the plant is wonderfully complete in all its details. The grinders, six in number, and hoists from the ore bins, are operated by a 500-hp type "C" Westinghouse motor. The Peck concentrators, which are the chief feature of this institution, are connected by a line shaft to another 500-hp induction motor. The high rate of speed at which it is necessary to run this machinery rendered it necessary to introduce some special features which made the demands on these motors specially severe. However, the plant is operating with great regularity. The hoisting of the concentrators is performed by means of two 20-hp induction motors, and the pumps by one 30-hp and one 20-hp motor, respectively. The works are lighted from the same transformers which furnish the power, and altogether the plant is very well provided in the way of current.

The plant of the Helena Light & Power Company is situated about 18½ miles from the generating plant. At this point there are six 150-kw transformers, from which are operated the lighting circuits which furnish light to the city of Helena. The high-tension voltage of 10,000 volts is transformed to 1100 volts, which is run to bus bars. From these bus bars each circuit is connected. In one leg of each circuit is a 10-per cent. Stillwell regulator, which takes care of any slight inequalities in regulation. The street railway in Helena is operated by two 175-kw rotary transformers. Since the introduction of these rotaries the service and the operation of the road have been wonderfully improved. The arc machines are connected to a line shaft, on each end of which is a 100-hp induction motor.

All of these plants are protected by Wurts non-arcing metal lightning arresters, and the satisfactory manner in which the circuits went through the late tremendous storms shows conclusively that the Wurts lightning arrester is not misnamed.

Much engineering skill was exhibited in the design and construction of the plant, which was attended by many serious obstacles

and difficulties. The apparatus had to be hauled for many miles over mountain roads, and a great deal of preliminary work had to be done before the dam and power house could be erected.

Much credit for the successful carrying out of the enterprise is due to Mr. J. T. Fanning, of Minneapolis, who was the consulting hydraulic engineer; J. G. White & Co., New York, the consulting electrical engineers; Mr. B. Sewell, of Chicago, the general manager, and Mr. C. W. Whitley, the superintendent of construction. It may be stated that the heaviest stockholders in the company constructing this plant are New York financiers, who form the smelting company mentioned.

On the Dimensioning of Armatures.

BY GEORGE T. HANCHETT.

IF special constructions and considerations are left aside it is a fundamental principle that the resistance of any armature should be as low as possible. If it could be reduced to zero, the C^2R loss would disappear, and the necessity of regulation for ohmic drop would be eliminated. As the C^2R loss is practically one of the largest individual losses in any armature, its reduction is a matter worthy of close attention, especially as the incidental advantage of better regulation is thereby obtained.

Among the causes that have acted to prevent the production of

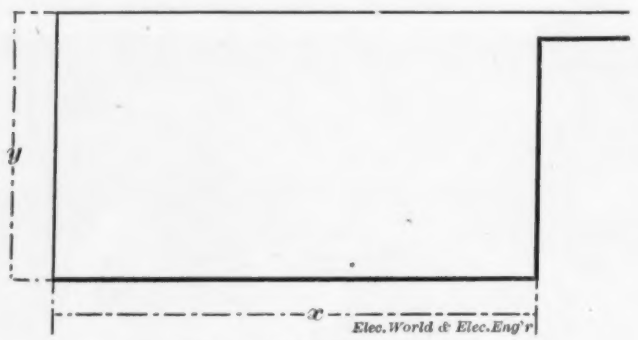


FIG. 1.—ARMATURE TURN.

low-resistance armatures is an erroneous idea concernnig the relative proportions of active and dead wire. The particular misconception to which the writer is about to refer is as old as the elongated magnet waists of the early Edison dynamo, and were it not for the fact that it is continually appearing in design and reaffirmed in revised works of standard authors it would not find a place in this discussion.

The active wire on an armature is that which cuts lines of force, and the dead wire is that portion of the coils which connects the active lengths together and to the commutator bars. The active lengths have been frequently called conductors and the dead lengths connectors. Of course it is desirable to have as little dead wire as possible.

With this object in view, many designers and even authorities recommend the device of lengthening the drum armature, in order to give the coils the form of an elongated rectangle, of which the long sides shall be the active wire and the short sides the dead wire. This unquestionably reduces the amount of wire, which is the seat of no electromotive force, but it by no means increases the volts per foot of wire or reduces the resistance of the armature, which are the practical objects to be obtained. The following demonstration should make this plain.

Suppose we have a wire of length K, which is to be formed into a rectangular armature loop. Of what dimensions shall this loop be in order that it shall generate a maximum e. m. f.?

Let S = The speed at which the loop is rotated in revolutions per second.

Let B = The allowable density per square inch within the loop.

Let x = The length of the sides of the rectangle forming the active wire.

Let y = The length of the sides of the rectangle forming the dead wire.

Let E = The electromotive force.

Let N = The total number of c. g. s. lines cut.

As the result is the same whatever the number of poles or type of winding, the bipolar form only will be considered. We have the following equations of condition:

$$E = \frac{2SN}{10^8} \quad (1) \qquad N = Bxy \quad (2) \qquad 2x + 2y = K \quad (3)$$

Whence

$$E = \frac{2BSxy}{10^8}$$

of which $\frac{2BS}{10^8}$ is constant, and may be denoted by C.

Hence, $E = Cxy$;

we substitute the value of x obtained from (3) and obtain

$$E = \frac{Cy(K-2y)}{2}$$

or

$$E = \frac{CyK}{2} - \frac{2Cy^2}{2}$$

differentiating with respect to y and equating to 0 for a maximum,

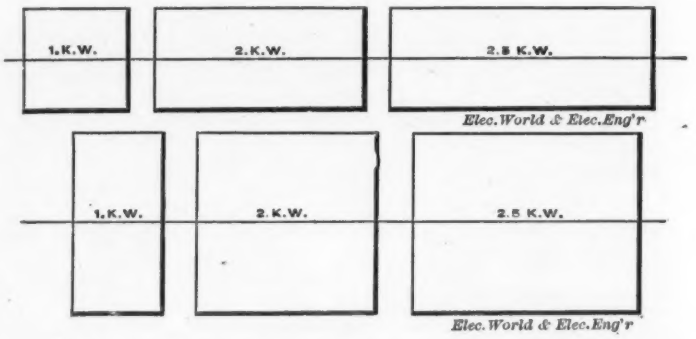
$$\frac{dE}{dy} = \frac{CK}{2} - \frac{4Cy}{2} = 0$$

whence $$y = \frac{K}{4}$$

and the most efficient shape is that of a square. This scarcely needs demonstration, for it is easy to see that a square will include more lines of force than any other rectangle.

The advocates of the long armature as a method of reducing the dead wire must, according to their reasoning, be limited in this practice only by mechanical considerations. To apply the "reductio ad absurdum" we may consider the armature in which the loops are one-half the length of their perimeter. In this armature there would be no dead wire, but its loops would have no area, and would generate no electromotive force.

It is to be appreciated that the square coil is only a condition to be aimed at, for economy in commercial construction will often require that a number of sizes of dynamos be built from the same core discs. It is customary among many manufacturers to start with an armature of square section and gradually lengthen it as they pass from size to size till mechanical considerations necessitate a larger armature diameter. Greater conductor velocity economy in weight and cost and lower armature resistance will be obtained by ranging these sizes about a square as a medium size, and, moreover, more different machines can be built from the same transverse section. Figs. 2 and 3, which illustrate the common armature sections and also the suggested series, will make this plain. The designer who has been in the habit of avoiding dead wire will look with considerable suspicion on an armature shaped as in the first of the suggested series, but a moment's thought should convince him. Consider Fig. 4, in which two armature loops which are identical are shown, but pivoted on different axes of symmetry. They are of



FIGS. 2 AND 3.—CROSS-SECTIONS OF ARMATURES.

the same area, and therefore are capable of receiving the same flux. If they are spun at the same speed in the same field they will generate equal electromotive forces. Their resistances are identical, and yet loop No. 1 has twice the dead wire that appears on No. 2. This should prove a most practical argument that dead wire is by no means useless wire, and that armature loops are by no means necessarily more effiicent because they have a large percentage of active length.

The selection of sections for a series of sizes proposed in Fig. 3 has another advantage which obtains in the actual output for a

given strength of field. Considering the two armatures of Fig. 4 as rotating at the same speed, it is plain, since they have the same magnetic area, that practically equal weights of field magnet in both iron and copper will magnetize them. Armature No. 1 has a slightly longer path for the lines of force, but as the armature reluctance is but a minute proportion of the total reluctance this is insignificant. The gap spaces with equal percentages of polar arc will be found to be the same.

Since armature No. 1 has twice the diameter of armature No. 2 it is evident that it will carry twice as many active conductors of equal current capacity to those of No. 2. Therefore, the total e. m. f. will be doubled, and as the current capacity is the same in

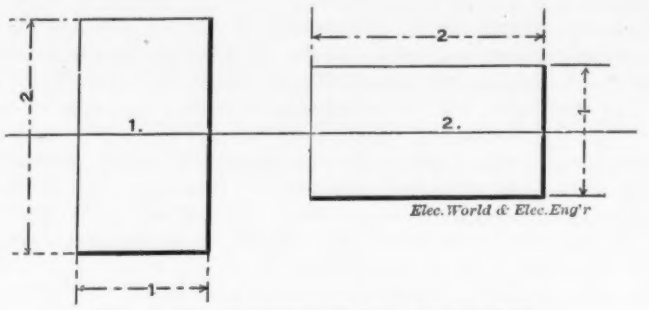


FIG. 4.—CROSS-SECTIONS OF ARMATURES.

both armatures, the output will be doubled also. The armature having twice as many loops has twice the resistance of armature No. 2, and twice the C^2R loss.

The ratio of the radiating surfaces is $\frac{8}{5}$ in favor of armature No. 1, and the relative volume of the two armatures is in the ratio of 1 to 2, the armature of larger diameter being the greater. Thus the hysteretic loss is also doubled. If both armatures are worked at the same temperature, it is evident that the armature of the larger diameter will carry nearly double the load of the elongated form.

These two armatures require about the same weight of field magnet, and the advantage, if any, is in favor of the armature with the short conductors, for the magnet waists may be made more nearly circular, which is the most economical form. Hence, it most emphatically follows that machines with long armatures are heavy for their output, and of high armature resistance for their voltage. They have, however, the advantage that their lesser armature reaction is almost completely quelled by the massive field magnets incidental to their construction.

In general, it may be said that machines with long armatures, instead of being preferred forms, as many designers believe, are to be avoided. High conductor velocity is a very inexpensive feature in any dynamo, and it conduces to light weight, lower speed, or larger output, as may be desired.

There is a method of reducing the resistance of the dead wire on armatures which will give valuable results, and which has not been widely practiced. This is to increase the section. Sectional area is jealously allotted to the conductors on an armature, and they are worked at the highest current densities that temperature considerations will allow. The end connectors are made of the same section, and invariably is this the case if the coils are made of one piece.

It is frequently possible to make the end connectors of much larger section than the conductors, especially in the case of Eickemeyer armatures, where the ends are formed of thin ribbon and joined to the conductors by soldered joints. In an armature with rectangular coils doubling the section of the end connectors would reduce he resistance of the armature and the C^2R losses one-fourth.

In the consideration of the foregoing several assumptions have been made which do not hold strictly true in practice. Among these it may be noted that armature loops are not simple rectangles, but the connectors are always somewhat longer than such an assumption would dictate. These considerations will modify the theoretical dimensions of maximum efficiency to a slight extent, but do not take from the force of the general conclusions which have been deduced.

Thawing Frozen Water-Service Pipes.

The recent continued cold weather offered opportunity for a new and odd application of electricity—to the thawing of frozen water pipes. Among those who have made use of the electric current for this purpose is Mr. F. H. Soden, an electrical engineer of Chicago, who has systematized the method of application and extended it to include underground service pipe. Mr. Soden has supplied us with the following information concerning the system which he used during the recent cold weather in thawing out service pipe:

The operation consists in uncovering and cutting the service pipe where it enters the basement of a building, thus disconnecting it electrically from the interior water-pipe system, and obviating danger from leakage of current to the numerous pipes and conductors usually about buildings. One wire of the secondary main of a transformer is connected to the indoor end of the pipe to be thawed, and the other wire connected to any convenient point of the water-pipe system exposed on the street, such as a fire hydrant, street-hose attachment, or to a faucet in an adjacent building. The current should be regulated to a safe carrying capacity for the respective pipes at their least conductive section.

The primary of the transformer is equipped with a reactive coil for regulation. The current should be such as to heat the pipe to about 50° Fahr., though 100° would not be injurious, and would, of course, hasten the work. Care should be taken, however, not to approach near the fusing point of lead pipe, which is at 617° Fahr.

As the ice becomes sufficiently loosened, the water from the main being under pressure forces a passage between the ice and the pipe and helps to clear its own way. The power needed will vary slightly in somewhat similar cases, generally according to the amount of ice contained in the pipe. The following are examples of the application of Mr. Soden's systems:

In the St. James' M. E. Church, Chicago, on February 18, 80 feet of 1-inch lead pipe, 45 feet of 6-inch iron pipe, and 30 feet of 1-inch lead pipe were thawed, the connecting conductor being a copper wire of 0.01 ohm in circuit with an ammeter which showed a current of 155 amperes at 25 volts, equivalent to 3775 watts. The water began to flow in seven minutes, and there was a full head in twelve minutes.

At a residence on Vincennes Avenue, Chicago, 85 feet of ¾-inch lead pipe and 22 feet of 6-inch iron pipe were thawed by a current of 190 amperes at 30 volts, or 5700 watts. The water started to flow in twelve minutes, and there was a full head in thirty minutes. In both cases the time could, if desired, have been shortened between starting of water and full head.

The apparatus used in both cases was a laboratory transformer

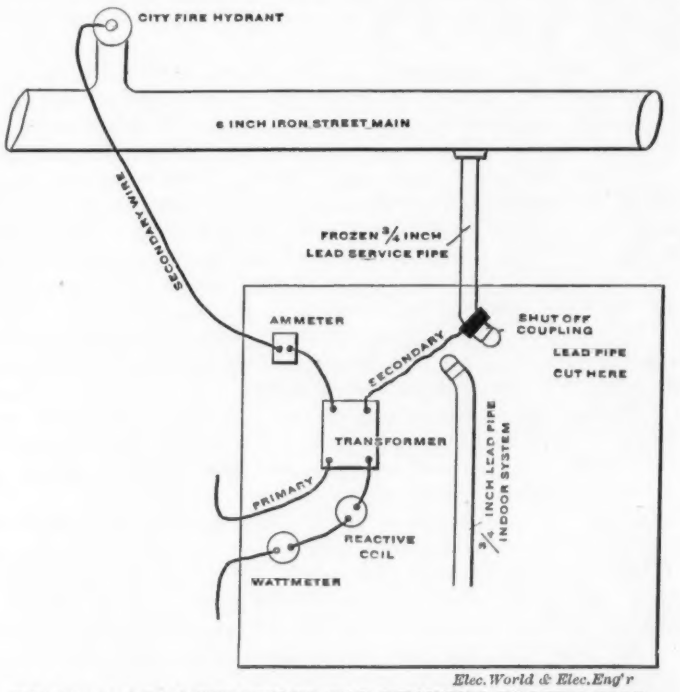


DIAGRAM OF CONNECTIONS FOR THAWING FROZEN PIPE.

connected to 125-cycle 1100-volt alternating lighting mains of the southern district of the Commonwealth Electric Company, of Chicago. The transformer was equipped with a reactive coil in series with the primary circuit, and the secondary so wound that by changing the connections, either 5 volts or multiples of 5 volts up to 50 volts could be secured independently of the reactive coil regulation. Thus a large amperage was possible with this apparatus, and fine regulation could be secured with the reactive coil when desired.

Electricity as a Factor in Modern Development.

THE annual university lecture to the corporation and students of McGill University, Montreal, was delivered on February 17, in Molson Hall, by Prof. R. B. Owens, professor in electrical engineering, on the above interesting and timely topic. Mr. Samuel Finley, one of the governors, presided, and briefly introduced the lecturer. Prof. Owens expressed great pleasure in being asked to deliver this lecture, and his appreciation of the facilities afforded to the university by its distinguished benefactor and governor, Sir Wm. McDonald,

In speaking of the effects of electric traction Prof. Owens stated:

"Few, perhaps, adequately appreciate the social influence of power, particularly of electric power, in modern life. Consider, first, electric traction. By its introduction not only have the sanitary conditions of our cities been improved, and an immense amount of time for pleasure or business saved, but healthy country homes have been substituted for the overcrowded tenement.

"To remove a large proportion of the working class from overcrowded areas, and to place them amid wholesome surroundings in a healthy atmosphere, is a task of which the engineer may well be proud."

The subject of "Improved Factory Conditions" was next discussed by the professor, who said, in part:

"In regard to electric power for industrial purposes, although I do not believe its general introduction will substitute the home workshop for the large factory, still the change from older methods of factory driving to the present one of using electric motors has a distinct and elevating influence upon the character of the men employed. The cleanliness, order and neatness which it renders possible are a potent influence for good.

"The modern electrically driven and lighted machine shop and factory has an elevating tendency as great as was the depressing effect of the smoke-filled, foul-smelling establishment it has often replaced.

"Indeed, it would not be difficult to show that to modern methods for the transfer of material, the distribution of power and the transmission of intelligence is largely due the moral transformation that characterizes this age."

In speaking of the changes which have taken place in social conditions of nations through the agencies of great and epoch-making inventions, Prof. Owens remarked:

"Nor must it be supposed that the engineer works blindly or to ill-defined ends. Master of the mechanic's skill and familiar with the results of scientific research, he forges with deliberation the lever he knows will lift the lives of all of us to higher social planes..

"Though filled with labor, and bringing small remuneration, as usually measured, the engineer's life has many compensations. The inspiring scenes of his daily work, the sure success if he has planned aright, and the fact that his efforts will be judged not by faulty human methods but by the immutable laws of the universe, are the pleasures and rewards that it offers.

"So it comes that no life is subject to sterner discipline than the engineer's; so it comes that an engineering training has so marked an effect in the development of character.

"Though having barely touched upon the engineer's work as a factor in material and social development, I hope that enough has been said to indicate what must necessarily be the result of engineering study on mind and character. Not only must habits of exactness in thought and action be formed but a respect for law becomes part of the student's nature.

"The inspiration that comes from the study of physical laws in their relation to social needs has an elevating and an ennobling influence as great as that of any to which man is ever subject."

The subject of university training and engineering practice was next discussed at length, and from this portion of the lecture the following abstract is taken:

"For the present, then, electrical as well as other special branches of engineering must be conducted as undergraduate work, but so rapid have been the advances in the development of electricity, and so vast are the facilities for experiment possessed by the larger manufacturing companies, that the school is, in general, behind the factory.

"Consequently every effort must be made to keep in close touch with best current practice. This it will be sought to accomplish here in two ways, first, by equipping the electrical laboratories with the best facilities for investigation that can be obtained, the greater number of machines upon which tests are to be made being supplied through an equitable arrangement by the manufacturing companies, as different new types are developed, the student in this way not only learning the principles of the subject, but also their application in current practice; and, secondly, by having practicing engineers, engineeers of the better electrical manufacturing companies, and others engaged in special work deliver lectures on special subjects from time to time."

Prof. Owens proceeded to discuss in more detail the developments in the several branches of electrical work. After briefly sketching the development of electrical lighting he went on to speak of the natural advantages of the Dominion of Canada for power developed and in particular of those of the city of Montreal. He next outlined the most interesting problems confronting the electrical engineer of to-day, namely, the efficient conversion of the energy of fuel into electric energy and the conversion of electric energy into light, without accompanying heat.

"Indeed, it is doubtful," he said, "if the art of government is sufficiently far advanced to withstand the social strain that such a revolutionary invention would produce. It would mean unlimited power at practically no cost, and would occasion industrial and social changes, beside which those produced by the steam engine would dwindle to a vanishing point."

In discussing the subject of "Power Distribution," Prof. Owens gave the following interesting figures:

"Power distribution by electric motors, though first developed in conjunction with electric lighting, not only now exceeds many times the lighting interest, but it has become one of the largest commercial enterprises of the globe. In 1898 more than a million horse-power in electric motors was employed in America, in street railway transportation alone, conveying, by a recent estimate, more than three billion passengers, and earning something like $125,000,000. These same railroads employ an army of 200,000 men, and represent an invested capital of from one to one and a half billions.

"When we further consider the aggregate capacity of the thousands of motors employed in the distribution of power for other than traction purposes—in machine shops, cotton mills and sugar houses, in printing, pumping, hoisting and ventilating, on modern warships for steering, handling ordnance, etc., to say nothing of the apparatus used in the transmission of power, as distinct from power distribution—we begin to form some adequate idea of the influence of this new agent."

After dealing with the question of electricity vs. steam, and making brief references to the telegraph and telephone, Prof. Owens concluded his lecture by the following remarks on the subject of automobiles and the effect of electricity on electro-chemical processes.

"The most marked feature of electrical development in the past year has been the astonishing growth of the electric vehicle business. Within a few months, orders amounting to $15,000,000 have been received by American manufacturing companies from Europe, and it is expected that the entire cab system of Paris will substitute electricity as a motive power before the end of the present year.

"Cleanliness, increased speed, and the easing of the congested traffic conditions in our crowded business districts are obvious results, but I also look for the betterment of our country roads, even to a greater extent from the use of the automobile than from the bicycle. The old days of post roads and country inns will be revived, but electricity instead of horses will be the motive power. Indeed, a company has recently been organized in Paris to carry out this very idea.

"The applications of electricity in electro-chemical processes and in the refining of metals is also most marked. In 1897 the output of German electrolytic alkali works alone was 20,000 tons, and in the past year it is estimated that more than 300,000,000 pounds of copper were electrolytically refined.

"Some 8,000,000 pounds of aluminum are also annually produced in the same manner, to say nothing of the various products of the electric furnace."

At the conclusion of the lecture Prof. Owens was greeted with enthusiastic cheering, in which the students took a prominent part. In a few apt words Principal Peterson expressed the appreciation of the audience, and the satisfaction of the university at the acquisition of Prof. Owens, and his colleagues, Profs. Walker and Rutherford, who were appointed at the same time.

NEWS AND NOTES.

The Electric Lighting of the Vatican.—The installation of 6000 incandescent lamps in the Vatican at Rome was inaugurated on Monday, February 20.

The Allen Law Repealed—The Illinois Legislature has repealed the Allen street railway law and re-enacted the "horse and dummy law" after being amended so as to apply to electric and cable railroads. The Allen law was enacted at the last session of the Legislature, and authorized city councils to grant fifty-year franchises to Illinois street car corporations.

Textile Mill at Niagara Falls.—Messrs. Alexander Morton & Co., of Darvel, Scotland, manufacturers of carpets and curtain fabrics, have arranged with the Niagara Falls Power Company for a factory site and power on the company's lands at Niagara Falls. The same firm has factories in Ireland and Belgium. Construction will be begun as soon as the weather permits.

Aluminum Line Wire for Electric Lighting.—The Waxahachie Electric Light Company, Waxahachie, Tex., has decided to use aluminum line wire in making its extensions, on account of the prevailing high price of copper. It has ordered 500 pounds of aluminum wire, and should the present prices for copper wire be maintained it will need several thousand pounds more for extensions in the spring.

The Southwestern Gas, Electric & Street Railway Association.—The annual convention of the Southwestern Gas, Electric & Street Railway Association will be held in Austin, Tex., on April 19, 20 and 21 next. Texas, New Mexico, Indian Territory, Arkansas, Louisiana and Mexico are represented in the membership of the association. The secretary anticipates a large attendance, and it is expected that there will be numerous and extensive exhibits on this occasion.

Volta Centennial.—The international electrical exhibition at Volta's native town, Como, to celebrate the beginning of industrial electricity in the discovery of the voltaic cell, will remain open from May 15 to October 15. Among the interesting features will be a historical exhibit of instruments, and apparatus, including some used by Volta. There will also be a collection of autograph letters by Volta, and a large number of medals and other testimonials awarded him by sovereigns and scientific societies.

Presentation to Mr. W. J. Johnston.—The recent and a number of former employees of THE ELECTRICAL WORLD, on Wednesday of last week, presented to Mr. W. J. Johnston a handsome sterling silver loving cup as a token of their esteem, and to commemorate his connection of a quarter of a century with electrical journalism. On one side of the cup, which has a capacity of four pints, is engraved an appropriate inscription, and on the other the names of the donors —twenty-four in number. On the following Saturday Mr. Johnston sailed on the Paris for a visit to the scenes in and about Cuba and Porto Rico rendered memorable by the late war.

The Electric Lead Reduction Company of Niagara Falls, has for some months past been carrying on an experimental process for the electrolytic reduction of lead ores to lead sponge. It is now installing a plant with a capacity to produce one ton of lead sponge per day, and expects in a short time to very greatly increase that capacity. The lead sponge is used for the manufacture of storage-battery plates by the simple process of moulding it into thin flat blocks with corrugated surface, under hydraulic pressure, and then forming them in the battery. It is also used to produce lead peroxide and other commercial oxides by electrical process or roasting.

The British Post Office to Equip Telephone Exchanges.—A cable report from London states that the Financial Secretary of the Treasury asked in the House of Commons on March 6 for an appropriation of $10,000,000, to be used by the Post Office Department to develop a system of telephonic communication in London, this to be the beginning of a general development throughout the United Kingdom. Heretofore the telephone exchange business has been controlled by the National Telephone Company, the Post Office building and operating only the trunk lines. One of the arguments advanced in the Secretary's speech before the House was the great inferiority of English telephone systems as compared with American.

Long-Distance Telephone Rates in France.—A new toll tariff has been put in force on the long-distance telephone lines of the French Government. The maximum time of conversations without extra charge has been reduced from five to three minutes, for which the rates vary from the equivalent of five cents over lines not exceeding 15 miles in length to a maximum of 60 cents. Within the territory of any department the maximum charge will be 8 cents, communication between departments being charged for at the rate of 15 cents per 45 miles or fraction thereof, the distance being measured on a straight line between the capitals of the departments. Hitherto the charge has been proportional to the length of the line itself, being equivalent to 10 cents for every 60 miles.

The Annual Meeting of the Commercial Cable Company.—The shareholders of the Commercial Cable Company held their annual meeting on Monday, March 6. The balance sheet for the year ending December 31, 1898, showed net earnings on the cables and land lines of the Postal Telegraph Company of $2,024,500, an increase of $107,409 over the previous year. $450,000 was added to the various reserve funds, which now amount to $3,037,103. The following named directors were elected for the ensuing year: John W. Mackay, James Gordon Bennett, Gardiner G. Howland, Col. William Jay, George G. Ward, Sir William Van Horne, E. C. Platt, Lord Strathcona and Mount Royal, Charles R. Hosmer, Thomas Skinner, Clarence H. Mackay, Albert B. Chandler and Dumont Clarke.

An Incandescent Arc Light.—Patent No. 620,308, issued February 28, 1899, to W. S. Hadaway, Jr., describes an arc light, the arc of which is closely surrounded by a sleeve of crystallized magnesia. This sleeve becomes incandescent, the lamp thus producing a light which is derived in part from the incandescence of the sleeve and in part from the arc whose light is transmitted through the walls of the shell. The sleeve is constructed by fusing magnesia in the electric furnace, the resulting crystals being then ground to powder and mixed in a plastic mass with magnesium chloride, the mixture being then moulded under heavy pressure into the required shape, giving a structure of sufficient strength and durability to be supported wholly by the carbons, without any inclosing casing.

Wireless Telegraphy.— On Thursday of last week Signor Marconi delivered an address before the English Institution of Electrical Engineers on wireless telegraphy, illustrated by practical demonstrations. He stated that communication had been maintained for months between the shore and the East Goodwins lightship without any interruption, despite all sorts of bad weather. Messages between the Queen at Osborne and the Prince of Wales on the royal yacht had been transmitted, in some instances for a distance of eight miles over land. Intervening hills, although 300 feet higher than the vertical wire at Osborne, offered no obstacle. During his lecture Signor Marconi received a note conveying the permission of the French government to establish his system between Folkestone and Boulogne. Signor Marconi states that vertical wires, rising to a height of 114 feet, will be sufficient to insure communication between the two coasts.

The Voice of the Thaw.—A few days ago nearly every telephone subscriber in Plymouth, Ind., was at the same moment called up with a violent ring, with the result that the air thereabouts was full of "Wells?" "Hellos," and interrogation points, and, probably, exclamation and other points a few moments later, when it was discovered that the alarm was a false one. The cause of this general uprising among the subscribers was an endeavor on somebody's part to thaw out a frozen water pipe by electricity. The application of an electric current as a means of thawing out frozen water pipes is quite widely and successfully used in the West just now, and in this particular instance an unlooked-for result developed. The ground-return telephone system is used in Plymouth, and as most of the ground connections are made with the water pipes, it was quite natural that the telephones should sound the danger alarm the moment a heavy current was applied to the troublesome pipe. It was a realization of the Munchausen fable of thawing out frozen speech.

The Long Island Railroad Company has let some of the contracts for the equipment on the overhead system of the portion of its Rockaway line, running between Far Rockaway and Rockaway Park, a distance of 7 miles. Both the electric and steam cars will use the same tracks, the electric cars running during the intervals between the regular steam trains. At the present time only one track connects the two places, but it is the intention of the company to lay a double track and run the overhead wire the entire length of the two tracks. The plan also contemplates the extension of the electric system through the streets of Far Rockaway, connecting with the electric service on the Long Island road. The object of this development is to provide better transit facilities between resorts on the beach, and is entirely independent of the through steam service on the road. The equipment work will be finished in time to take care of the summer traffic. Messrs. Jacobs & Davies are the consulting engineers, and Mr. W. H. Knight will have general supervision of the work.

A New Type of Fuse.—A thermal cutout for electric circuits, designed to operate below the temperature at which a fuse would melt, and thus avoid the disadvantages of molten metal, is described in patent No. 620,309, issued February 28, 1899, to W. S. Hadaway, Jr. The result is obtained by using metallic magnesia, either as an entire fuse or as a coating or a conducting strip of other metal. The magnesium combines rapidly with the oxygen of the atmosphere at a temperature below its melting point, and in case it is used upon copper it produces a decomposition of the latter with great rapidity at a temperature far below that at which the copper itself would fuse. The oxidation takes place more rapidly under high air pressures, and the invention describes the fuse as inclosed in an air-tight inclosing chamber, the pressure in which is raised by the heating of the fuse. The temperature at which the magnesium is oxidized may be governed with still greater accuracy by coating it with a layer of oxidizing material, such as binoxide of manganese, which gives up its oxygen at a definite temperature below the melting point of magnesium.

Plans for the Meeting of Municipal Electricians.—Letters received from John W. Aydon, president of the National Association of Municipal Electricians, Wilmington, Del., confirm the report that the next meeting of this association, to be held in that city, week beginning September 4, will be a distinct success. At the present time there are 110 cities in the United States and Canada represented. President Aydon has secured a fine exhibition hall, 86 feet by 53, with an annex of 22 by 44 feet. Space is given free to those who wish to exhibit their goods at this convention. The following well-known corporations have secured locations for exhibition purposes: The Gamewell Fire Alarm Telegraph Company, 19 Barclay Street, New York; Montauk Multiphase Cable Company, New York; the Okonite Company, New York; Standard Underground Cable Company, New York; Habirshaw Wire & Cable Company, New York; Shelby Electrical Company, J. S. Wilson, Boston; F. M. Ferrin Municipal Cable, Boston; Frederick Pearce, electrical supplies, New York; M. & I. Electrical Company, T. J. Smith, manager; the National Conduit & Cable Company; the National India Rubber Company, and W. R. Brixey, of Day's Kerite. Many interesting features and attractions will be included in the programme.

A Century Franchise at New Rochelle.—The opposition shown by wealthy residents in the suburbs of many large cities to the inroads of the trolley has in the end usually succumbed to the pressure of the needs of the population as a whole, and one more repetition of the experience has now been witnessed at New Rochelle and Rye, pretty suburban towns eastward of New York city. The main contention there on the part of the "residenters" was that the beauty and value of a fine driving road would be spoiled by the trolley, and the argument was by no means without validity. But, despite the vigorous protest of wealthy proprietors at Mamaroneck, whose property is on the old Boston road between New Rochelle and Rye, a franchise covering one hundred years has been granted for the operation of a trolley line through that handsome thoroughfare. Every means possible to prevent the building of the trolley was resorted to by the residents. The end is not yet, however, as undoubtedly the wealthy residents at Mamaroneck and Larchmont will undoubtedly take legal action to prevent the road from being built, although the franchise has been granted. The fare is to be 5 cents within the town. It is currently reported that the Union Trolley Company holds an option upon this system, which is now ostensibly to be in the hands of the Tarrytown, White Plains & Mamaroneck Trolley Company.

Reduction of the Losses of Transformers on Multiphase Systems.—There has long been proposed but rarely put into practice a method of reducing the losses of transformers by arranging the windings in different series-parallel groupings under different loads. For instance, the primary and secondary of a transformer should be made up each of two coils, which could be placed in parallel with each other at times of heavy load, while at times of light load the two coils of the primary could be connected in series, those of the secondary being similarly connected, giving the same ratio of transformation. The advantage of this change is that it reduces the induction in the iron 50 per cent. and the iron losses by somewhat more than 50 per cent. While, of course, the series connection increases the copper losses, yet these are small at times of light load, and the whole change is a saving. An elaboration of this idea, especially adapted to three-phase work, has been covered by E. L. K. F. Kahlenberg, in patent No. 620,144, issued February 28, 1899. The three primary windings of a three-phase transformer or three single-phase transformers are connected with a switch by which they may be connected either in the star of delta grouping, the three secondaries being similarly arranged. As is well known, the delta grouping with the same potential difference between terminals gives an e. m. f. force to each winding 70 per cent. greater than does the star grouping, the current in the coils being correspondingly less. By adopting the star grouping under light loads and the delta grouping under heavy loads, the induction in the iron can thus be changed and a considerable saving in the total loss effected.

A Peculiar Accident.—So simple a thing as replacing an old water hydrant with a new one, downtown in Manhattan, New York, one day last week, caused the wholesale violation of the third commandment and utter demoralization in many of the financial, commercial and industrial beehives in that section of the city. The water department of the city decided to put in a new hydrant in front of the station of the New York Steam Company at Washington and Dey streets, and the result was that the steam company was deprived of water for its boilers, and unable to supply its many customers with steam. The elevator service in those buildings depending upon this steam supply was suspended, and, for two hours or more, the occupants were compelled to climb aloft afoot, via the stairs. One of the most peculiar and serious results of the suspension of the steam supply was the practical paralysis of telegraph service from the Western Union Company's main office at 195 Broadway. Here the New York Steam Company's power is depended upon for the operation of the engines of the dynamos which supply current for the wires. For nearly two hours the operating department of the Western Union Company was helpless. Business was affected in many of the large downtown buildings on account of the stoppage of elevators and lights. The New York Steam Company claims that the water department did not give it proper notice that the water supply was to be shut off, while, on the other hand, the water department claims that it gave the company due notice, and that it had time to store a sufficient amount of water to tide it over the temporary suspension of service.

Mr. Thomas A. Edison, Jr.'s Latest Discovery.—After a period of quiescence, Mr. Thomas A. Edison, Jr., has announced to the world, through the medium of the New York "Herald," the discovery of a process for hardening steel, which he claims is far superior to any known method of accomplishing this result. He and his uncle, Mr. Holzer, discovered the process accidentally last summer while experimenting along radically different lines. He claims, according to the "Herald's" story, that a 6-inch armor plate treated by his process has a resisting power superior to that of a 15-inch Harveyized plate, and is much superior to a plate treated by the Krupp process, while the cost is less than one-half. Armor plates are to be submitted to the Government to be tested, this test having already been arranged for, he says. One point of superiority over the Harvey process, which Mr. Edison claims is that while only a shell about an inch thick is hardened on each side of a Harveyized plate, a plate treated by his process is hardened all the way through, and is rendered much more elastic. Tests

made by the Bessemer Iron Company last June of steel treated by the Edison process showed that the tensile strength had been increased from 68,000 pounds per square inch to 71,600 pounds, and the elastic limit from 39,000 pounds to 51,000 pounds, while the expansion and contraction had been decreased from 29.33 per cent. to 24.66 and from 63.65 per cent. to 62.14. But this is not all. If Mr. Edison's discovery is accurately reported, there will be no more railroad accidents on account of spreading rails, because steel rails treated by his process will never spread. Furthermore, a razor similarly treated will shave for two months without being stropped. That is what a razor did last summer. And even then, after two months' tonsorial service, "a grindstone was unable to produce a new edge until the razor had been annealed." The process is also applicable to copper, and the world is led to believe that the lost art of the ancients of hardening copper has been rediscovered. Glass can also be rendered so hard that it will scratch diamonds. It is stated by the "Herald" that a company—the Thomas A. Edison, Jr., and William Holzer Steel & Iron Process Company—has been organized in West Virginia to get out of the discovery all there is in it. Mr. Edison declares, however, that the company will only maintain a small experimental plant at Poughkeepsie, and will not manufacture steel itself. The rights to do this will be sold to others. The company has a capital of $1,000,000, which will be increased to $25,000,000 or $30,000,000 if the Government tests do not knock the claims and plates all to flinders.

A New College Magnetic Observatory.—The Massachusetts Institute of Technology has established a geodetic observatory, intended primarily for giving instruction in the most refined methods of determining latitude and longitude, and for observations on the force of gravity. It is also used for magnetic observations, for which it is fitted with a magnometer and a dip circle. A hill in the southeastern part of Middlesex Fells, a public park of Boston, is the site, a location practically undisturbed by mechanical vibrations and magnetic disturbances. The observations on the earth's magnetism at this point will probably be incorporated in the general magnetic work of the United States Government.

LETTERS TO THE EDITOR.

An Electrolytic Lamp.

To the Editor of Electrical World and Electrical Engineer:

Sir—Having experimented with the oxides used by Professor Nernst, I have designed a new form of lamp, which obviates the long wait before the oxide conducts the electricity. The apparatus I use is an arc lamp, the upper carbon of which is raised by a magnet connected in series to form an arc. Around the arc I have placed a hollow cylinder of oxide connected in shunt around the arc. When the switch is turned on no current flows through the oxide, but as the carbons complete the circuit the magnet raises the upper carbon and the arc thus formed heats its jacket of oxide, which soon conducts the electric current under the intense heat evolved and becomes incandescent. The arc between the carbon electrodes is broken, owing to the increased length of the arc and the reduced current which now passes through the incandescent cylinder of oxide. The upper carbon is fed by gravity when the current is turned off, prepared to again impart the initial heat.

I have successfully operated three such lamps connected in series on 110 volts direct current. THEO. REYMAN.

NEW YORK, N. Y., March 6, 1899.

Double-Current Generators.

To the Editor of Electrical World and Electrical Engineer:

Sir—I was somewhat interested in your article in THE ELECTRICAL WORLD of March 4, under the heading of "Double-Current Generators," in which alternating currents and continuous currents are taken from the same dynamo, and in which there is but a single winding in the armature.

The European manufacturers have no doubt been the first to put such a machine into practical use as an industrial undertaking, but I would say that in the early part of 1894, while developing certain alternating-current work for the General Electric Company, I built such a generator and operated it in connection with work in my laboratory. The machine was a two-pole generator having a single armature provided with commutator and collector rings and driven by a belt, and of something more than one-hp capacity. The field-magnet coils were in shunt relation on the direct-current line, and the collector brushes on the alternating-current rings connected with the alternating-current line. The armature coils were connected diametrically to opposite points with the collector rings, and were otherwise connected with the commutator sections in the customary manner for direct-current generators. I still have this machine.

I simply mention this as showing that the actual idea of building a combined generator for alternating and continuous currents was known in this country long prior to the use of them abroad.

PHILADELPHIA, March 4, 1899. R. M. HUNTER.

Rates for Public Lighting in Small Towns.

The managers of a lighting plant in a place of 3500 inhabitants have written the letter printed below, asking for information on the rates for public lighting given by companies similarly situated and giving precisely their own circumstances. Anyone interested and desiring to communicate with them confidentially may do so through the address "Information," care of the Editor of ELECTRICAL WORLD AND ELECTRICAL ENGINEER, New York.

To the Editor of Electrical World and Electrical Engineer:

Sir—We think the city lighted by our firm is obtaining as cheap public lighting as any city under like circumstances in the country. We submit full particulars, and would be pleased to hear from interested parties. We have an actual population of 3500, spreading over quite a country, requiring 8½ miles of pole line; having a total of 1600 lights wired up, operating the Edison three-wire system with water as motive power. We supply the city with 135 16-cp and twenty-two 24-cp lights, burning all and every night; five 5-ampere enclosed arc lights, burning every night until midnight; light the City Hall with twenty 16-cp lights, which are used about the same hours as they are used in stores, with one all-night lamp. We also light a small city park with six 24-cp lights every night until midnight from May 1 to September 15; all for the sum of $2000 per annum, the firm furnishing all renewals and repairs. Putting the City Hall and park lighting at our regular commercial rates would amount to $100, and the arc lights at $400 per annum, or both $500, and subtracting this from the total received would leave $1500; then, putting the twenty-two 24-cp street lights into equivalent 16's, would make 167 16-cp, or a trifle less than $9 per lamp per annum.

Efficiency of 220-Volt Lamps.

To the Editor of Electrical World and Electrical Engineer:

Sir—I have been looking for an article or an editorial commenting on the efficiency of the 220-volt lamp as at present manufactured. The installation of 220-volt 2-wire or 440-volt 3-wire direct-current lighting systems seems to be growing in favor, especially in the smaller cities and towns. The principal drawback to such a system is, and has been, the inefficiency of the 220-volt incandescent lamp, although the efficiency of the 220-volt lamp is generally greater than that of the 110-volt lamp and the transformer combined.

The writer has installed 2-wire 220-volt central stations in the past two years. The last one has been running about ten months, and as the patronage has greatly exceeded the expectations the plant is loaded nearly to its full capacity. It will be necessary, therefore, either to install additional machinery or to increase the efficiency of the system in some way.

The lamps we are using are of a well-known make, and consume 64 to 68 watts per 16-cp lamp. (The lamps run slightly above candle power.) There are about 150 lamps that burn all night. The rest of the lamps will average about four hours' burning per night. The plant has been in operation 230 nights, averaging thirteen hours a night, making a total of 3640 hours. Our lamp renewals during that time have been just seventy-three lamps! I wrote to the firm making the above lamps asking for a 3-watt lamp. They said they had been experimenting for a long time on 3.5-watt 220-volt lamps, and hoped to succeed in a few months!

To the best of my knowledge there is no manufacturer in the United States making a 220-volt lamp of higher efficiency than 3.8 to 4.2 watts per candle power; and yet our lamps are burning six times as long as they are guaranteed to last, and we are pull-

ing 25 per cent. greater load than would be necessary with a 3.2-watt lamp. To aggravate the matter the consumers furnish the renewals, and as there are no meters, they are not careful about turning the lights off when not needed.

All of the 220-volt lamps made at present, I presume, are intended for power circuits, the voltage of which may fluctuate. It seems to me, however, that it ought not to be an experiment to make a high-efficiency 220-volt lamp to be used on the increasing number of exclusive lighting circuits of 220 volts, when two filaments such as are used in high-efficiency, 110-volt, 8-cp lamps might be placed in series.

MERRILL H. FISHER.

Lake City, Ia., March 3, 1899.

DIGEST
OF
Current Electrical Literature.

By CARL HERING.

Dynamos, Motors and Transformers.

SURGING OF PARALLEL CONNECTED GENERATORS.

It happens sometimes that steam-driven, direct-connected dynamos, which can be connected in parallel without difficulty, will afterward begin to surge—that is, to develop a pendulum-like oscillation. This is the case only with direct-connected, steam-driven dynamos, but never with such as are driven by turbines or belts, and the cause, therefore, appears not to lie in the dynamo but in the method of driving, as the torque produced by a steam engine is never absolutely constant; in practice a constancy between a hundredth and a three-hundredth is in general sufficient for parallel driving, but this surging action does not seem to be dependent on the constancy of the steam engine, and it sometimes develops quite slowly, which leads to the belief that it is due to a sort of resonance. This question is discussed in detail by Mr. Kapp, in an article appearing in the "Elek. Zeit.," Feb. 16. In practice it is necessary to know how this pendulum action can be prevented, and for this there are two solutions. One is to dampen such oscillations when they occur, which may be done by surrounding each pole of the field with a thick copper ring: as long as the armature is in absolute synchronism with the current in the bus bars these copper bands exert no action, but as soon as it is leading or lagging, the band begins to act, and, according to Lenz's law, it will brake or accelerate the armature so as to bring it into synchronism. This method, however, is costly, and cannot always be applied, owing to difficulties in the construction, the centrifugal force of revolving poles, the limited space, etc. The second method is to prevent the cause of this pendulum action—that is, to prevent resonance. If the steam dynamo is so constructed that the period of oscillation of the electrical part is sufficiently different from the period of the steam engine, resonance cannot exist; this method has the advantage of cheapness, but to apply it it is necessary to calculate the period of oscillation of a dynamo in advance, and this is the problem which he then works out with the aid of simple mathematics, giving formulas for calculating these factors. He shows that every dynamo has a period of oscillation which is dependent only on the electrical and mechanical relations, but not on the load. He applies the formulas to a 500-kw, 3000-volt dynamo, and finds that the periodic time of the tandem steam engine is 0.35, and that of the armature 0.55 second, showing that the latter is about one and a half times the former, which means that there will be no resonance and therefore no pendulum action. In general the danger is greatest when these two periods are equal, but surging can exist also when the latter is one-fourth, one-third, one-half, one, three or five times the former, or nearly so. Increasing the mass of the flywheel can therefore sometimes be a disadvantage if it causes those relations to approach these values. If these values are found to exist the copper bands might be employed, or both, or any one of these values may be changed, so as to change this ratio. Or a choking coil may be connected, which will change these ratios, increasing the period of the dynamo, a method which has already been used with good results. Dynamos with solid poles are not as liable to develop this pendulum action as are such with laminated poles, as the solid poles act somewhat like copper bands.—Kapp. "Elek. Zeit.," Feb. 16.

A NEW TRANSFORMER DIAGRAM.

A method for obtaining the instantaneous values of the primary and secondary currents and the magnetic flux of the transformer, which he believes to be new, is described by Mr. Baum, in the "Phys. Rev.," Feb. He endeavors to express the instantaneous values of these three varying quantities with their angular relations, in terms of the self-inductance and resistance of the two coils and the impressed e. m. f. The resulting diagram is simple and applies to every possible case, and the method of obtaining it is said to be straightforward. The use of the diagram is probably only for giving a mental picture of the whole phenomena, but the algebraic results show that it is no more difficult to solve a transformer problem in this way than any problem in simple alternating-current series circuits. The assumption generally made that the secondary circuit is 90° behind the primary is nearly true for a small load, but becomes less true as the external resistance is reduced, and he therefore considers the assumption unnecessary. The paper is highly mathematical in character, but some of the conclusions are of interest. In all problems concerning the primary or the line feeding it he shows that the transformer may be replaced by a single coil of a certain self-inductance, and the same resistance as the primary, the applied e. m. f. being replaced by one having a certain value, and in advance of the true e. m. f. by a certain angle. In this way it becomes possible to solve completely the problems of the multiple transformer circuit, each transformer being replaced by a single coil, the total current being obtained by geometric summation. This is on the assumption that there is a non-inductive load and no hysteresis. In general, however, any transformer may be replaced by a single coil having a certain coefficient of self-induction and equal resistance, and an e. m. f. whose value bears a certain relation to the real one, and at a certain angle. In the same way the solution of problems in the receiver circuit may be solved. He refers also briefly to the case of successive transformations.—Baum. "Phys. Rev.," Feb.

MAGNETIC LEAKAGE IN TRANSFORMERS.

Some years ago (see "Digest," April 10, 1897) Mr. Russell published some formulas for predicting the current, secondary voltage and efficiency of a transformer at various loads, but in these he made the assumption that there was no magnetic leakage between the primary and secondary windings. As this assumption, although practically true for many commercial transformers, is far from true for some types and for many large ones, he now supplements his previous article with a discussion of the effect of the magnetic leakage on these formulas, which is begun in the Lond. "Elec.," Feb. 17. The discussion is mathematical in character. Magnetic leakage is a drawback in the design of transformers, and if it could be gotten rid of transformers could be made more cheaply; the efficiency also alters very much with the shape of the wave. The only practical method heretofore used for measuring the leakage is to find the inductive drop in volts in the secondary at full load, by subtracting from the open circuit secondary voltage the secondary voltage at full load and the drop due to the copper; as that due to leakage is rarely half of the total, it is not easy to measure the leakage in that way. The angle of lag of the secondary current behind the voltage occurs in nearly all the formulas, and as this can easily be measured by four different methods it seems to be the best way of measuring the leakage. He then proceeds to discuss the theory of the transformer, and applies the formulas to published tests.—Russell. Lond. "Elec.," Feb. 17.

REFERENCES.

Limits of Sparking with Continuous-Current Dynamos.—A long translation in abstract of the article noticed in the "Digest," Jan. 28.—Kapp. Lond. "Elec. Eng.," Feb. 17.

Constant-Current Dynamos.—Brief, well-illustrated descriptions of recent improvements, taken from patent specifications.—Guilbert. "L'Eclairage Elec.," Feb. 18.

Lights and Lighting.

TRANSMISSION PLANT OF THE NORTHERN RAILWAY OF FRANCE.

The Northern Railway of France has a large number of central stations along its lines for both lighting and power, and in order to make the load as uniform as possible the neighboring stations are connected so as to interchange a supply of current. Formerly this was done with high-voltage continuous currents, but for greater distances this has been replaced by the alternating-current system, with the use of the rotary transformers of Hutin and Leblanc, which were here used for the first time. A very brief description of these is given in a recent paper by Dr. Wessely, published in abstract in the "Zeit. fuer Elek.," Feb. 12. For transforming three-phase into continuous currents the iron core has a primary coil around which are wound eighteen secondaries, whose number of windings vary according to the sine law. Three such transformers are placed next to each other, and the ends of the secondaries are connected together, so that the number of windings bear a certain relation to each other. The beginnings and ends of each of the groups of three series-connected coils are led to eighteen slide rings, which are connected to a collector driven by a small motor. In this way a continuous current of 160 volts is transformed into three-phase currents of 4 to 5000, transmitted 6 to 8 kilometres and then transformed down again for charging accumulators. The arrangement is furthermore such that by different groupings of the transformer coils different voltages from 150 to 600 can be generated.—Wessely. "Zeit. fuer Elek.," Feb. 12.

THE NERNST LAMP.

In view of the approaching financial operations in connection with the introduction of this lamp, the Lond. "Elec. Rev.," Feb. 17, states that the General Electric Company of Berlin, which owns the German patents of Nernst, stated in its recent report in

December that, in spite of its simple appearance, the lamp is complicated in structure, and that the greater economy and higher candle power are discounted by two disadvantages: in larger sizes it requires a secondary heating coil, and its temperature when in use is much higher than that of the ordinary incandescent lamp. The report adds that it is not expected that the Nernst lamp will displace to any great extent the ordinary incandescent lamp on account of these disadvantages.

In another part of that journal Mr. Whitcher claims that the connections to the refractory filament are likely to prove to be a serious feature. These must be subject to very high temperatures, as there is practically no grading down of the latter toward the ends of the filament. If the connections are of platinum wire they must be long, for otherwise they will conduct off too much heat. He believes the failure of the lamp with platinum terminals is thereby indicated.—Lond. "Elec. Rev.," Feb. 17.

DIFFERENTIAL ARC LAMP.

The resistances which are connected in series with arc lamps when they are connected to constant-potential circuits are, of course, a source of loss of energy, and it is to avoid this that a certain lamp, known as the Vigreux and Brillie, was devised, an illustrated description of which is published in "L'Ind. Elec.," Feb. 10. By making it a differential lamp—that is, one in which the regulation depends on both the current and the voltage—it has been possible to do without the series resistance; moreover, the lamp is said to be of a strong construction, not delicate, and the regulation is claimed to be quite sensitive. The system of regulation involves the principle of the brake. These lamps are run two in series, on circuits of 75 to 85 volts, three for 110 to 135 volts, five to six for 220 to 250 volts, and ten to twelve for 440 to 480 volts. In one installation a 50-ampere 46-volt lamp is being run in series with two 25-ampere 44-volt lamps, which are in multiple with each other, the group being connected to a 110-volt circuit; the difference of 10 volts is absorbed by the leads and regulators, thus leaving 90 per cent. of the total power utilized in the arc.—"L'Ind. Elec.," Feb. 10.

REFERENCES.

Efficiencies of Motors in Groups or Singly.—An abstract of the article noticed in the "Digest," Oct. 8.—Hartmann. "L'Eclairage Elec.," Feb. 18.

Traction.

ACCUMULATOR TRACTION AT OSTEND.

The operating data of this small but apparently very successful line were recently given in a short paper by Mr. Sarcia before the International Society, which is reprinted in "L'Ind. Elec.," Feb. 10, and "L'Eclairage Elec.," Feb. 11. The line is only 2½ miles long. The dynamo at the charging station has a capacity of 35 kw, but the load on it is very variable, owing to the method of charging used. A table gives the itemized cost per car kilometre during 1897, the total being 3.2 cents, including coal, oil and waste, attendance, handling of the batteries (but apparently not their amortization), motormen and conductors. This result is claimed to be remarkable. Another more detailed table gives the results for 1898, during which time 27,363 kilometres were run. The total is slightly less than 4 cents. This includes certain items, such as track cleaners, which are not generally included, and for making comparisons with the usual figures certain deductions should be made, which diminish this figure to 2.76 cents. This includes no interest or depreciation, except the daily repairs of motors and batteries. Recently the positive plates have been repasted with active material, but this was apparently done since the figures were compiled. The installation is said to be a model one; it is to be copied in a larger plant at Gand, where there will be 24 miles of track, with 35 cars, all run by accumulators. The consumption of energy per car kilometre at the switchboard at Ostend has averaged, for two seasons, 650 watt-hours, and the coal consumption per car kilometre, including lighting, has been about 4.4 pounds, or about 6.6 pounds per kw hour, This result is claimed to be remarkable when it is considered that the steam engine is only one of 50 horse-power, with no condensation and a variable load, as the batteries are charged successively. In conclusion, some tabulated results of tests of power consumption are given, showing the consumption on Vignole rails; the average consumption was 343 watt hours per kilometre on the car, presumably at the motor terminals; Westinghouse motors are used on the cars.—Sarcia. "L'Ind. Elec.," Feb. 10, and "L'Eclairage Elec.," Feb. 11.

ELECTRIC CANAL HAULAGE.

A note in "L'Elec.," Feb. 18, states that this system is soon to be introduced into Belgium. A large parent company seems to have been formed, and appears to be arranging for the introduction of canal haulage on a large scale.—"L'Elec.," Feb. 18.

REFERENCES.

French Electric Locomotive.—A long, well-illustrated description of the experimental locomotive of the Paris, Lyons & Mediterranean Railroad in France, a briefer description of which was published in THE ELEC. WORLD Feb. 4.—Auvert. "L'Eclairage Elec.," Feb. 18.

Automobile Accumulators.—A list of the nineteen batteries which have been entered for the competitive tests by seventeen different makers. Certain well-known accumulators are not included.—"L'Ind. Elec.," Feb. 10.

Electric Traction for Heavy Railway Work.—A long abstract of the article noticed in the "Digest" Feb. 25.—Feldmann. "Elek. Zeit.," Feb. 16.

Installations, Systems and Appliances.

REFERENCES.

Electrical Installations in Lyons.—A short article by Houllevigue giving brief descriptions of the applications of electricity in that city, including telephony, light, traction, etc. This is followed by a long, illustrated description by Rayval of the electric railway, on a portion of which the conduit system is used with a length of a little over 2 miles, while for most of it the American trolley system is used.—"L'Eclairage Elec.," Feb. 11.

Switches and Cut-Outs.—A reprint of a long topical discussion before the International Society, including numerous illustrations of various forms of switches and cut-outs. Being largely descriptive in character, the article does not admit of being abstracted.—"Bul. Soc. Int. des Elec.," Jan.

An abstract of the continuation of the discussion is published in "L'Eclairage Elec.," Feb. 11. A briefer summary is given in "L'Ind. Elec.," Feb. 10.

Wires, Wiring and Conduits.

REFERENCES.

Wiring Rules.—Long abstracts of the discussions of the recent papers by Crompton, Wordingham and Pigg are published in the Lond. "Elec.," Feb. 17. Brief abstracts are also published in the Lond. "Elec. Rev.," Feb. 17. Part of the discussion is also abstracted in the Lond. "Elec. Eng.," Feb. 17. At the conclusion a resolution by Crompton was unanimously carried; it was to the effect that the Institute should take steps to secure the uniformity of rules by urging the supply companies, engineers and insurance companies to adopt rules to be drawn up by that institution, based on the present ones. The subject is also discussed in the leading editorial in the Lond. "Engineering," Feb. 17.—The Lond. "Elec. Rev.," Feb. 17, publishes a new set of rules issued by an insurance company.

Electro-Physics and Magnetism.

HYSTERESIS AT VERY LOW TEMPERATURES.

Some investigations have been made by Mr. Thiessen, which are described in the "Phys. Rev.," Feb., in which he made a comparative study of the hysteresis of iron, steel and nickel-steel at three different temperatures, that of the room, that of boiling water, and that of solid carbon dioxide, all at different values of the maximum magnetizing force. The ballistic method was used. The results showed in general that hysteresis losses increase with decreasing temperatures when the maximum magnetizing force causes approximate magnetic saturation, and that the reverse is true for a low magnetizing force. He also makes some deductions with the aid of Steinmetz's law, in which he compares the losses at different temperatures when the maximum induction in each case is the same, as distinguished from the maximum magnetizing force. He then found that the hysteresis loss is in all cases less at the high temperatures. His conclusions do not agree with the results obtained by Fleming and Dewar, whose method is thought to be susceptible of error on account of the Foucault currents, as they used alternating currents.—Thiessen. "Phys. Rev.," Feb.

INFLUENCE OF THE SURROUNDING DIELECTRIC ON THE CONDUCTIVITY OF A WIRE.

Some years ago Professor Sanford made the somewhat startling announcement that from experiments he found that the dielectric surrounding a wire affected the conductivity of the latter, and he therefore claimed that Ohm's law must be modified; in some instances the difference was as much as 0.25 per cent. Other investigators have since endeavored to find whether this is true or not, and various results were obtained, but as these differed, Mr. Merill repeated the experiments in a more refined way, using large lengths of wire and measuring the temperature more accurately; the results are published in the "Phys. Rev.," Feb. He shows that if there was any change in the conductivity of a wire due to the surrounding dielectric, this change was not greater than 0.01 per cent.—that is, there was no change greater than the probable limits of experimental error. Notwithstanding Sanford's announcement, Ohm's law has continued to be used, but it is nevertheless a comfort to know now that it is correct.—Merill. "Phys. Rev.," Feb.

STEREOSCOPIC X-RAY IMAGES.

In a short French Academy note by Roullies, reprinted in "L'Ind. Elec.," Feb. 10, he suggests a method based on the persistence of vision. By a special apparatus two images formed by two tubes are seen in rapid succession by the right and left eye respectively, and are thereby superposed, and thus produce the effect of relief. The instrument called an "obturator" operates synchronously with the lighting of the tubes and enables each image to be seen only by one of the eyes, the two images being seen in rapid succession. No further description is given.—Rouillies. "L'Ind. Elec.," Feb. 10.

ALTERNATING CURRENT MAGNETIZATION.

Some researches were recently made by Mr. Wien to investigate the behavior of soft iron under the influence of very rapidly alternating currents, the frequencies being 128, 256 and 520 per second. The cores were toroids made of thin iron wires and wound with magnetizing coils, and the form of the magnetizing current was very approximately sinusoidal. The researches are described in "Wied. Ann.," No. 13, and abstracted briefly in the Lond. "Elec.,"

Feb. 17. It was found that the magnetic induction was not simply sinusoidal, but that inductions of higher periods were superimposed on the fundamental ones, thus adding their own eddy currents to complicate and increase the loss of energy. As a general result he found that the magnetic induction is not capable of keeping up with very rapid oscillations of the field; the effect is that the hysteresis loops are shortened and broadened out, thus imparting a virtual hardness to soft iron. An important observation is that it is practically useless to separately insulate the laminations of the core, as the effect of the Foucault currents is the same in bare and insulated wires, being fully accounted for by Oberbeck's theory.—Wien. "Wied. Ann.," No. 13; abstracted briefly in Lond. "Elec.," Feb. 17.

ENERGY DISSIPATED IN MAGNETIZATION.

Mr. Maurain measured the energy expended in a complete cycle at different frequencies on solid and laminated cores in the form of an anchor ring, a description of the researches being given in the "Jour. de Physique," 7, p. 461, and noticed briefly in "Science Abstracts," Jan. The enclosed area representing the hysteresis and Foucault current losses is nearly oval for the solid core, and diminishes as the frequency is increased, which is due to the shielding effects of the induced current. As the core is divided up more and more, the area approaches more nearly the well-known form of the B H curve for soft iron, and its area diminishes less and less for high frequencies. For the smallest subdivision, the wires being 0.2 mm in diameter, the shape is that of the well-known form, and the area is practically the same between frequencies of 24 and 55. In all the curves he found that the maximum of the induction lagged behind that of the current, this lag being greater the less divided the core, owing to the induced currents. The lag, however, appears in the case of the most divided core, and he therefore considers it a true lag of the magnetization behind the existing field and independent of the induced currents.—Maurain. "Jour. de Physique," 7, p. 461.

REFERENCES.

Resistance to Electrical Oscillations.—In some articles recently published in "Nuovo Cimento," Jan. and April, 1898, by Mr. Cardani, good abstracts of which are published in "L'Eclairage Elec.," Feb. 18, he describes some experiments confirming the law of Stefan, namely, that in electrolytes currents of even high frequencies distribute themselves throughout the whole section of the conductor. He also made some experimental verifications of the formulas of Lord Rayleigh and Stefan for the resistance of metallic conductors to high-frequency currents, in order to find the limits of those formulas.—Cardani. "Nuovo Cimento," Jan. and April; "L'Eclairage Elec.," Feb. 18.

Theory of Electricity and Heat.—The beginning of an article of a highly mathematical character, describing the theory advanced by Riecke in the "Wied. Ann.," 64, pp. 353 and 545.—Lamotte. "L'Eclairage Elec.," Feb. 11.

Constants of the Earth's Magnetism.—The constants for the first of January of this year at the French Observatories, as given in an Academy paper.—"L'Ind. Elec.," Feb. 10.

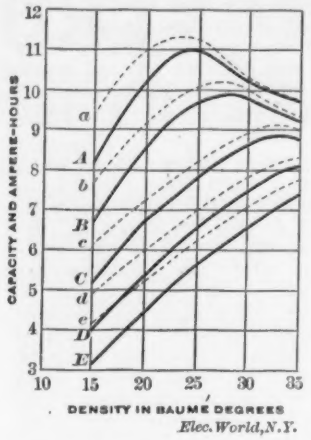
Diurnal Variations of Terrestrial Magnetism.—A discussion of some of the laws.—Luedeling. "Berlin Akad. Sitzber," 36, p. 524; noticed briefly in "Science Abstracts," Jan.

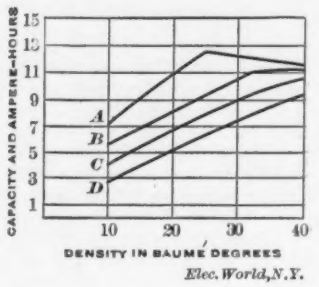
Earth's Magnetic Elements in Potsdam.—The numerical values for 1897.—Eschenhagen. "Wied. Ann.," 65, p. 951; abstracted briefly in "Science Abstracts," Jan.

Electro-Chemistry and Batteries.

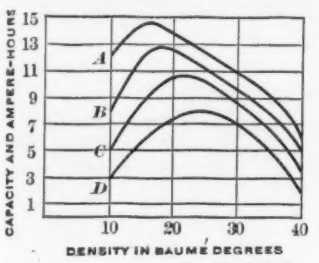
RESEARCHES WITH THE LEAD ACCUMULATOR.

A series of interesting researches were recently made by Mr. Jumau, in which he endeavored to find the variation of the capacity of an accumulator with the concentration of the acid. After having found that for identical electrodes under the same condition the capacity was small for dilute solutions, increased with the concentration up to a maximum, and then diminished again for still greater concentrations, he endeavored to find whether this maximum was invariable or whether it depended on the rates of discharge used. His experiments were made with Faure plates, which were selected so as to have exactly the same capacity under the same conditions; with these he made up a number of cells, in each of which the density of the acid was different, and for each cell he determined the curve of variation of the capacity for different rates of discharge, commencing and ending with small rates, so that the series of tests made a complete cycle for which the mean values could be taken. The curves which he obtained in this way are shown in the adjoining figures. The first set are for the accumulator as a whole, the full lines being for a discharge down to 1.8 volts, and the dotted lines for 1.7 volts. These curves show very clearly that the concentration corresponding to the maximum capacity varies with the rate of discharge; moreover, there is a well-indicated maximum at about 25° for the smallest discharge rate, the maximum point moving to the right for greater rates. The densities were not increased beyond 35° B., as such concentrated acid could not be used in practice on account of the rapid sulphating of the spongy lead-plate which is produced thereby. He then made a similar series of experiments, but arranged the plates so that the capacities were limited by the positive plates in one case and by the negative in the other, in this way determining the effect of the density of the acid on each of the plates separately. This he accomplished by using one plate between two others of greater capacity, so that the metal plate was sure to be the one to be discharged first. Moreover, the difference of potential was measured between the middle plate and a small auxiliary plate in the same liquid, but not in circuit, so that it may be considered as remaining constant. The quantity of liquid in the cells was so great that variations in its concentration during the discharge could be neglected. The second set of curves were obtained in this way for the positive plates, the discharge being continued down to 1.7 volts. The curves bear some similarity to the preceding set, except that the maximum points are less sharply defined, and are for higher





concentrations. The last set of curves refers to similar tests with the negative or spongy lead plate, and they show maximum points in a very marked way; also that these maxima are for much lower concentrations. These curves show that for the best possible conditions the liquids in contact with the two plates should be separated by a porous cup, the density of that for the positive plates being relatively great, while for the negative plates the acid should be dilute. Use of porous cups, however, is impracticable, and a single concentration must therefore be chosen; this should be greater the greater the rate of discharge; a concentration of 35° B. should, however, not be exceeded.—Jumau. "Eclairage Elec.," Feb. 11.



(While these results are of considerable interest in connection with accumulators of the Faure type, it is to be regretted that he did not also continue them with plates of the Planté type, for which the results might be quite different, at least for plates containing a very thin coating of active material, which is quite freely exposed to the acid, so that the effect of the difference of concentration of the acid in the pores and in the electrolyte is not nearly as great as in the Faure type.)

CHROMIUM.

Referring to the list of the prices of very rare metals, which was noticed in the "Digest" last week, Dr. Goldschmidt, in the "Elek. Anz.," Feb. 12, states that, by means of his process of reducing chromium with aluminum (in the aluminum furnace referred to a number of times in the "Digest"), it is possible to obtain very pure metallic chromium in large masses, the cost of a kilogram being only a few marks (one mark is about 24 cents). This metal has the same property as gold, that in the air it remains unoxidized. He adds that if it becomes possible to plate articles with chromium, as is now done with nickel, very valuable advantages would arise, as in contact with the air it remains much more stable than nickel. Unfortunately, however, it has not been possible to do this, but now as the metal itself is cheap, and could be used as a soluble anode, it may become possible to devise such a process of plating.—Goldschmidt. "Elek. Anz.," Feb. 12.

In another part of the same issue it is stated that in a French Academy paper by Placet, published in "Comptes Rendus," 1892, pp. 115 and 945, a process is described for obtaining a fine polished coating of pure chromium from its alum solution mixed with a little sulphuric acid or an alkaline sulphate. It is added, however, that the requirements of a good deposit of chromium were not fulfilled.

ELECTRO-DEPOSITION OF VANADIUM.

What appears to be a good, but brief, summary of existing information on the electro-deposition of this metal is given by Mr. Cowper-Coles in the Lond. "Elec. Rev.," Feb. 17. It includes a brief description of the properties of this metal. He himself has obtained a brilliant white deposit of it with a current density of about 18 amperes per square foot, and 2.5 volts, the solution being made by dissolving the anhydride in a slight excess of sodium hydroxide acidified with hydrochloric acid, the temperature being 70 to 75° C.; great care is necessary to have the proper current density, as the metal is otherwise deposited as a black oxide. This metal in-

creases the tensile strength and ductility of iron, copper and aluminum. At present it is used almost exclusively for making black aniline dyes, for indelible ink and for coloring glass.—Cowper-Coles. Lond. "Elec. Rev.," Feb. 17.

PRODUCTION OF ALKALI AND CHLORINE.

The improved form of the Le Sueur process was described by Mr. Parsons at the meeting of the American Chemical Society in Boston, last August, an extract of which is published in the Lond. "Elec.," Feb. 10. Carbon is no longer used for the anodes, very thin sheets of platino-iridium being substituted, as it is claimed that on the long run this is considerably cheaper than carbon. The gases are collected in a bell-shaped receiver closed at its lower end with a diaphragm of asbestos, the liquid inside having a slightly higher level than on the outside. The process is said to be working with fair success on a tolerably large scale at Rumford Falls, Me. In an editorial in the same issue it is thought that there is no reason why the process should not be largely used where power is cheap; it is rather wasteful of energy, but the plant is simple and the units are large.—Lond. "Elec.," Feb. 10.

MANUFACTURE OF ARTIFICIAL SUGAR.

A note in "L'Elec.," Feb. 18, states that at one of the recent meetings of a Belgian chemical society Mr. Sloss claimed to have succeeded in making sugar, or a material like it, by synthesis. He passed a current of two volumes of hydrogen and one volume of carbonic acid gas, both pure and dry, through a Berthelot ozonizer and obtained a crystallized body having all the properties of sugar, such as reducing the Fehling solution and answering other tests. By a similar treatment of one volume of oxide of copper and two of ammonia he obtained urea. No further description is given.—"L'Elec.," Feb. 18.

ELECTROLYTIC PREPARATION OF GLUCINUM.

Mr. Lebau, in "Comptes Rendus," 126, p. 744, describes the following method: A double fluoride of glucinum and sodium, which is a conductor, is electrolyzed in a nickel crucible, which serves as the negative pole, the positive being a plate of graphitic charcoal. The metal is deposited in pure form as crystals.—Lebau. "Comptes Rendus," 126, p. 744.

REFERENCES.

Electrolysis of Zinc Chloride Solutions.—A long abstract of the article noticed in the "Digest" Aug. 6.—Foerster and Guenther. "Science Abstracts," Jan.

Units, Measurements and Instruments.

MEASURING THE SPEED OF SMALL MOTORS.

In measuring the speed of very small motors, say below 0.25 horse-power, difficulties arise because the speed counter is apt to lower the speed. To overcome this Dr. Benischke, in a recent paper printed in the "Elek. Zeit.," Feb. 16, describes a simple stroboscopic method of measuring speeds; as also the frequency of an alternating current and the slippage of non-synchronous motors. The motor to be tested has an ordinary ventilating fan connected with it; another motor is provided with a disc with radial openings through it, and is placed opposite the one to be tested, so that the fan and the disc partially overlap, enabling the former to be seen through the holes in the latter; this second motor is connected with a speed counter, and can be varied in speed; when the two speeds are nearly equal, assuming that the number of slots is equal to the number of wings to the fan, the latter will appear to rotate slowly in one or the other direction, and when the speeds are quite equal they will appear to stand still. At that moment the speed of the second motor is counted. A similar method can be applied to measuring the frequency of an alternating current when access to the generator cannot be had, and when there is no synchronous motor at hand. A bottle of water is so arranged that a small, vertical stream flows out of it in front of a small motor connected to a disc with slots in it; the bottle is mounted on a stand connected to an armature opposite an electromagnet, through which the current whose frequency is to be measured flows; this shaking of the bottle will break the stream of water into drops, whose number corresponds to the frequency of the current; when the number of slots passing the line of sight per second is equal to the frequency the drops seen through them will appear to be at rest, and at that moment the speed of the motor is measured, from which and the number of slots the frequency is then calculated. In this experiment a curious result is obtained when the disc revolves somewhat slower, as the drops then appear to travel upward into the bottle. Instead of a broken stream of water an alternating arc lamp can be used, the light being passed from it through that rotating disc on to a screen, the speed of the motor being measured when the light on the screen ceases to surge. To measure the slippage of a non-synchronous motor the arc lamp may be used, and the disc will then appear to rotate slowly; by counting these apparent rotations in a certain time the slippage can be determined very accurately, as it is proportional to this apparent rotation. This is illustrated by an example showing how much more accurate that method is than the usual one.—Benischke. "Elek. Zeit.," Feb. 16.

ALTERNATING CURRENT INSTRUMENTS.

The new form of instruments described by Dr. Benischke in the article noticed in the "Digest," Feb. 25, was claimed to be independent of the wave form of the alternating current. Mr. Szapiro, in the "Elek. Zeit.," Feb. 16, however, claims that those instruments will be as dependent on the curve form as all other electromagnetic measuring instruments. In a previous article in that journal he showed theoretically that every coil with or without iron, having resistance and self-induction, will take less current for a given voltage the more the voltage curve deviates from the true sine curve, a fact which was shown experimentally later by Roessler and Wedding with arc lamps. This, he believes, is the chief reason why electromagnetic volt and watt meters depend on the curve form. In the instruments referred to the torque will depend on this current, and therefore on the curve form. When the inductance is considerable, as compared with the resistance, he believes there may be differences of several per cent. in the readings of these instruments.—Szapiro. "Elek Zeit.," Feb. 16.

CALIBRATING CONTINUOUS CURRENT INSTRUMENTS.

In an article on the methods of recalibrating commercial instruments, published in the "Elek. Anz.," Feb. 12 and 16, the copper voltmeter is recommended and the method of using it is described. Besides this, there is little else of value in the article. The copper voltmeter is applicable for measuring current from 4 to 10, and even 12, amperes, but not more. The best current density per square decimeter is from 2 to, at most, 3 amperes. He suggests plates having a surface on one side of 2 sq. cm.; the cathode should be made of platinum and the two anodes on each side of pure copper, all the plates being of the same size. The solution should be chemically pure copper sulphate prepared with distilled water, and it should have a specific gravity of 1.12 to 1.14; the temperature should be kept down to 15 to 20°. For larger currents it should be shunted so that only a known fraction passes through the voltmeter; in this way it can be used for currents up to 80 amperes.—"Elek. Anz.," Feb. 12 and 16.

SILVER VOLTAMETER AND STANDARD CELLS.

Kahle made an investigation to show how far the silver voltameter can be relied upon for standardizing, and gives the results in an article in the "Zeit. f. Instrumentenkunde," 18, pp. 229 and 267, a brief notice of which is given in "Science Abstracts," Jan. For the same current density, temperature and treatment, an accuracy of one in ten thousand can be obtained. A platinum surface receives a somewhat smaller deposit than an already existing silver deposit. Fresh solutions deposit less readily than those which have already been electrolyzed. To get all of the silver nitrate out of the deposit repeated cold washing and subsequent washing for one hour in water at 80° is necessary. The results of the standardizing experiments are summarized as follows: Ratio of Clark cell at 15° to cadmium cell at 20° is 1.40663; Clark cell at 15°, 1.4328 int. volt; cadmium cell at 20°, 1.0186 int. volt; Clark cell at zero, 1.4492 int. volt.—"Zeit. f. Instrumentenkunde," 18, pp. 229 and 267.

INDUCTION COIL INTERRUPT R FOR ALTERNATING CURRENTS.

It is in general not satisfactory to operate induction coils from commercial alternating currents. In order to enable this to be done Dr. Kalischer describes a method in the "Elek. Zeit.," Feb. 16, by means of which the alternating current is interrupted, thus producing an interrupted direct current. This is accomplished without movable parts or sparks, by using one of the so-called electric valves in series with the coil. It consists of a sheet of aluminum as the anode in potassium or sodium alum, and, as has been described before, this will permit a current to pass in one direction but not in the other, provided the voltage does not exceed a certain amount. This would stop the current in one direction, but allow it to pass in the other; to utilize both the currents a second coil may be connected in multiple with the other, and in series with another valve, in which the electrodes are reversed.—Kalischer. "Elek. Zeit.," Feb. 16.

ELECTROSTATIC WATTMETER FOR HIGH-TENSION CURRENTS.

A new form of instrument is described by Mr. Arno, in the "Torino R. Accad. Sci. Atti.," 33, p. 593, a brief notice of which is given in "Science Abstracts," Jan. With a paraffin paper cylinder in a rotating electrostatic field the work done by hysteresis at high inductions is proportional to the square of the induction or the voltage. This principle he applies to a wattmeter consisting of four quadrants surrounding a metallic cylinder with a paraffin paper cylinder in the annular space between them. One pair of quadrants is connected to the two points between which the voltage is to be measured and the other to the secondary of an open-circuit transformer, whose primary carries the main current. The deflections will then be proportional to the watts in the circuit.—Arno. "Torino R. Accad. Sci. Atti.," 33, p. 593.

INTERNAL RESISTANCE OF STANDARD CELLS.

The importance of the internal resistance in certain measurements is pointed out in a recent article by Klemencic. Some of the standards made according to the Reichsanstalt receipts show enormous variations of resistance with temperature; one of them, for instance, had 8620 ohms at 20.8° C., and 30,800 at 11° C. The straight form of Clark cell has distinct advantages over the H form in resistance.—Klemencic. "Wied. Ann.," 65, p. 917; noticed briefly in "Science Abstracts," Jan.

ELECTROCHEMICAL EQUIVALENT OF SILVER.

In a recent contribution from the German Reichsanstalt by Dr. Kahle, he gave the results of carefully made comparisons of the Clark and cadmium cells, with the Helmholtz electro-dynamometer and the electrochemical equivalent of silver, and obtained as a final value of the latter 1.1183 milligrams per second, which is in accordance with the previously obtained value.—"Wied. Ann.," No. 1, p. 1.

REFERENCES.

Fault Testing.—A brief description of slight alterations in the author's previously described method, in order to enable the Mance method to be used in connection with it, this being desirable in many cases where the fault is liable to polarize. With their original method it is possible to localize a fault without necessitating communication between the two terminal stations after each reading, the result being attained by the two stations taking alternately a certain number of readings, balancing to a pre-arranged resistance.—Jordan and Schonau. Lond. "Elec. Rev.," Feb. 17.

Measuring Low Resistances with the Differential Galvanometer.—A short article in which he calculates the most sensitive arrangement for measuring low resistances with a shunted differential galvanometer, the shunt of one of the coils being the resistance to be determined; the shunt of the other coil should then be infinite—that is, the coil should not be shunted.—Pomey. "L'Eclairage Elec.," Feb. 18.

Measuring the Conductivity of Electrolytes.—A new method is described by Professor Cardani in "Nuovo Cimento," Jan., 1898. and noticed briefly in "L'Eclairage Elec.," Feb. 18. It is based on the displacement of the meniscus of a "thermometer calorimeter." The method is claimed to be simple and precise.—Cardani. "Nuovo Cimento," Jan., 1898.

Recording Voltmeter.—A brief, illustrated description of one made by Elliott. The voltmeter part is like that in the Weston instrument; the clock part is wound up from the outside, so that it may be rewound without opening the case, which is locked.—Lond. "Engineering," Feb. 17.

Loss in Condensers.—A publication of the same article that was noticed in the "Digest" last week.—Rosa and Smith. "Phys. Rev.," Feb.)

Hiecke Meter.—A translation in abstract, with the illustration, of the article noticed in the "Digest" Feb. 11.

Telegraphy, Telephony and Signals.

ELECTRICITY IN THE BRITISH POST OFFICE.

Some data of interest were recently given in a paper by Mr. Preece concerning the British Post Office, of which he was the chief engineer, which is abstracted briefly in the Lond. "Elec. Eng.," Feb. 17. The object of the paper seems to be to show the great progress made during his administration, which has now terminated. During that time the length of telegraph wires in that country had increased from 60,000 to 300,000 miles, while the business increased four times as fast and four times as much work is now done by the same length of wire, due to the improvements made by the officers of that service. The improvements have led to the development of a provincial daily press, and that service is carried out at a great loss. There are 158,997 telephones in use; in 1897 that office took over 29,000 miles of wire of trunk lines, which has since been increased to 56,000 miles, and the receipts have doubled since the introduction of the automatic system of signaling used in America. The post office produces its own electricity at 2 cents per kw hour, and is replacing the old primary batteries by accumulators. The electricity produced by the primary batteries costs $1.50 per kw hour, as against 2 cents by the present system. Sixty-two thousand seven hundred and eighty-two primary batteries have already been replaced by 2784 accumulators, but there still remain about 300,000 to be replaced by one-twentieth of that number of accumulators. He believes that wireless telegraphy has a great future.—Preece. Lond. "Elec. Eng.," Feb. 17.

CHARGING FOR TELEPHONE SERVICE.

A new method of charging has been suggested in a bill to be considered by the German Government, which is described and discussed editorially in the "Elek. Zeit.," Feb. 16. The subscribers are to be divided into seven classes, according to the number of conversations, and the cities into four classes, according to the number of subscribers. For each class of subscribers there is a fixed charge per year, which will be between $20 and $47.50, and will be larger as the number of subscribers is larger. A table is published giving the mean cost of a single conversation on this basis; these figures vary, for the smallest places between 1.2 and 4.8 cents, and for the largest between 1.5 and 6.8 cents. For the present charge of $37.50 per year the mean for the whole of Germany is slightly less than 1 cent for a conversation. The time limit is to be three minutes. An estimate is also made of the percentage of utility, or what might be called the efficiency factor of the installation, and it is found that under normal circumstances the installation would be used only during about 3.7 per cent. of the whole time, or double this when the receiving instrument also is taken into account.—"Elek. Zeit.," Feb. 16.

MEGA-TELEPHONE TRANSMITTER.

A somewhat unusual form of microphone invented by Kilduchevesky and successfully tested in Russia is described briefly, with an illustration, in the Lond. "Elec. Rev.," Feb. 17. The chief feature is that the microphone is enclosed in a vacuum tube, or in a tube containing an inert atmosphere, the object being to allow powerful currents to be used without injuring the contacts or having them affected by atmospheric moisture or other disturbing conditions. It is said that the current may be increased to any required extent without liability to oxidation of the contacts, and that no packing can occur. It has been tested successfully in Russia over distances up to 2000 miles (but the gauge of the line wire is not given), and on an artificial cable in England, equal to a length of about 200 miles, having a resistance of about 600 ohms and a static capacity of about 60 microfarads, the K R being, therefore, nearly 36,000. The microphone itself is supported in the tube by the leading-in wires, which are quite large.—Lond. "Elec. Rev.," Feb. 17.

TRANSMITTING SOUND BY ULTRA-VIOLET RAYS.

A short Academy note in which the author repeated the classic radiophone experiments, but replaced the light rays by ultra-violet rays, which act on selenium by means of a fluorescent substance. He has in this way transmitted sound, and even words, to a little over 33 feet.—Dussaud. "L'Ind. Elec.," Feb. 10, and "L'Elec.," Feb. 18.

REFERENCES.

Telephone Switchboard.—The multiple switchboard system of Scribner, with single cords, is simpler than the double-cord system in construction and operation, but according to Ambrosius it is not as sure and reliable, the chief objection being in the earth switch. To overcome this the present author devised a new system, also for metallic circuits, which he describes, and in which this objection is said to be overcome.—Ambrosius.—"Elek. Zeit.," Feb. 16.

Simple Signaling Through a Single Wire.—Supplementary to the article noticed in the "Digest," Feb. 18, concerning a method of communication by means of Hertzian waves over a wire, an experiment is described, which indicates the principle on which this method is based.—Lond. "Elec. Eng.," Feb. 17.

Telegraph and Telephone Statistics.—A reprint of some of the tabular statistics noticed in the "Digest" Feb. 25.—"Elek. Zeit.," Feb. 16.

Miscellaneous.

CONNECTING STEAM PIPES AND LIGHTNING RODS.

In a brief communication to the "Elek. Zeit.," Feb. 9, information is asked for concerning the possible danger or advisability of connecting steam pipes and other large metallic masses with the lightning rod, assuming that the boiler is already connected to earth. In a reply by Mr. West (one of the editors of that paper), he states that there is not only no danger in making such a connection, but, on the contrary, there would be danger in not connecting them. The connection is best made at the highest point of the steam pipe and at a place where these pipes approach the lightning rod most closely. Special earth connections should be made with the bottoms of high metallic columns carrying the pipes. If there are in the immediate neighborhood of these pipes any other metallic parts which are earthed more effectually, then a good connection should be made between them.—"Elek. Zeit.," Feb. 9.

ELECTRIC TIMBER SEASONING.

An illustration of the apparatus used in the method described in the "Digest" Feb. 25 is published in the Lond. "Lightning," Feb. 16. Some of the figures given differ somewhat from those in the previous description. The present one, which is very brief, states that the average power used is about 600 watts per cubic meter of wood. The wood can be seasoned in about eight hours, and is dried in hot-air chambers in winter, or in open air in summer. The tank is kept at a temperature of about 145° Fahr. By this method it is claimed that wood which is otherwise useless can be made serviceable; maritime pine, for instance, which never dries in the open air, can be so perfectly dried that it may be used for soundboards of pianos. The process seems to be a success on the Continent, and the press connected with the building trades speak highly of it.—Lond. "Lightning," Feb. 16.

SENSATION OF TASTE PRODUCED BY ELECTRICITY.

Recent experiments were made by Mr. Zeynek, who found that the sensation of taste produced by an electric current through the tongue was dependent on the voltage. He measured the current and voltage with a platinum plate below the tongue and a platinum point above it, and endeavored to find whether there is any change in the sensation of taste corresponding to the sudden bends in the curve of the current and voltage, which correspond to the beginning of the setting free of ions. This, he found, was the case; when the platinum point is made the cathode, then, at 1.45 volt, an astringent taste is produced; and when it is the anode at 1.2 volt, there is a strong acid taste. This is believed to prove that the phenomenon of the electric taste is an electrolytic one.—Zeynek. "Centralbl. f. Physiologie," Dec. 10; abstracted briefly in "Zeit. f. Elektrochemie," Feb. 9.

ANNUNCIATOR FOR INDICATING LACK OF LUBRICATION.

A simple device for closing a circuit and thereby ringing a bell, when the supply of oil to a bearing ceases, is described by Aliamet in "L'Elec.," Feb. 4. One of the chief advantages of it is that it announces the fact before any harm is done to the bearing. It consists simply of a very small funnel at the end of a horizontal balanced lever, the other end of which dips into mercury. The oil from the cup drops into the funnel and from there on to the bearing, and as long as the funnel is nearly full of oil its weight will keep the circuit open.—Alimet. "L'Elec.," Feb. 4.

REFERENCES.

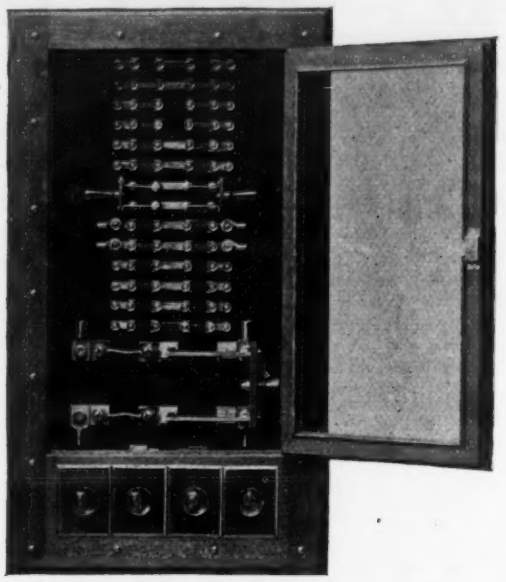
The Soldier as an Electrician.—The beginning of an article in which the growing importance of a knowledge of electricity by the soldier is pointed out.—de Fodor. "Zeit. fuer Elek.," Feb. 5.

A New Type Junction Box.

The illustration represents a new type of junction box manufactured by Messrs. Johnson & Morton, 26 and 28 Catharine Street, Utica, N. Y.

The tablet board containing the fittings of the box is removable, and can be placed in the box after all wiring is installed and after

the interior finishing of the building is complete, thus preventing any possibility of damage to the finish of the visible parts of the box. The concealed wiring pocket allows the wires to be brought in through the back, top, bottom or sides of the box as may be most convenient, making the boxes standard, independent of the location of the outlets. All of the branch circuits are supplied with detachable fuseholders, consisting of an insulating bar with heavy copper ends, which makes sliding contact in substantial jaws. The use of this holder enables the replacement of fuses while current is on, without danger of short circuiting. All of the copper work is

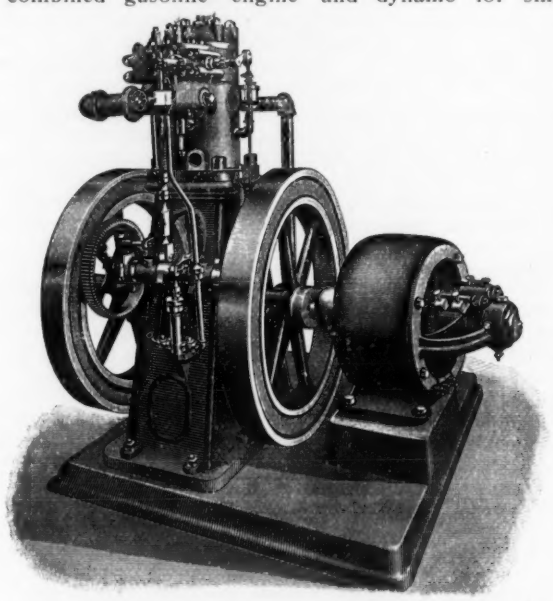


JUNCTION BOX OF NEW DESIGN.

highly polished and lacquered, the slate is enameled, baked and polished after all drilling is completed, and the woodwork is hand-finished. These boxes are easily installed and connected up, and have received the approval of the National Board of Fire Underwriters.

A Gasoline Engine and Dynamo Combination.

To meet the demand for a satisfactory, simple, compact and cheap combined gasoline engine and dynamo for small isolated plants, the Coal Handling Machinery Company, 74-80 Pratt Street, Chicago, Ill., has brought out the outfit shown in the accompanying illustration. The engine is known as the Cornell engine, and the combination is notable for the absence of intricate parts. It is stated that the regulation is so good, and the governor so sensitive, that a perfectly steady light can be obtained, even with the plant left to the care of a janitor or a porter. In the design of this machine the distribution of metal is such that the frame is exceptionally strong and rigid, being extended for the reception of both the engine and dynamo. The base is heavily flanged, and when it is firmly bolted to a solid foundation of cut stone or Portland cement there is no vibration.



DYNAMO DIRECT-CONNECTED TO GASOLINE ENGINE.

The company has made several exhaustive tests of this machine, with satisfactory results in each case. A 2½-hp gasoline engine direct-connected to a 1½-kw dynamo lighted twenty-five 110-volt 16-cp incandescent lamps for forty-eight hours without intermission. Hourly voltmeter records were taken during the test, and these showed less than an average of ¾ per cent. fluctuation, and at no time could the eye detect a flicker in the lights. At the end of the forty-eight hours' run a tachometer was attached to the crank shaft, and by shifting from full load to no load and from half load to full load the engine maintained a steady speed throughout.

This combination outfit is recommended to the trade by the company with the utmost confidence that it will furnish a steady light at an exceptionally low rate of fuel consumption. These outfits are made in sizes from 2½ horse-power to 50 horse-power, and are guaranteed.

Hoisting Engine and Coal Conveyor Driver.

Of the accompanying illustrations, Fig. 1 gives a view of one of the many sizes of the Hunt electric hoisting engine, which is manufactured by the C. W. Hunt Company, of New York. These machines are built for high, moderate and low hoisting speeds, and are properly proportioned for any load and speed desired. The bearings are supported by and are solid with the heavy side frames, each bearing being bushed with a replaceable phosphor bronze bushing. The machines throughout are built to gigs and templets, and in no way is the work dependent upon workmen's measurements. The armature shaft runs in bearings on the main frame in such a manner that the pinion is not overhung, but is supported by the bearings, making a very stiff and smooth-running machine. In construction the armature is located by its shaft in the bearings, after which the fields are adjusted accurately to the armature and then

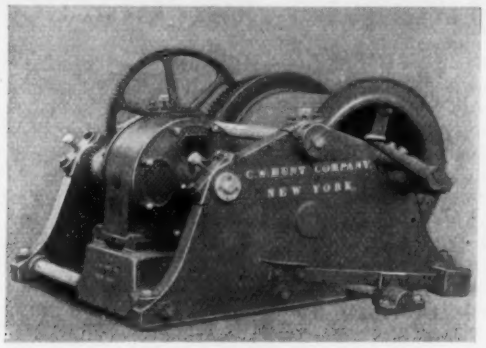


FIG. 1.—ELECTRIC HOISTING MACHINE.

fastened rigidly to the distance bars of the machine. For this reason the machine, when received, is ready to go to work, and needs no setting up, in the ordinary sense of the word.

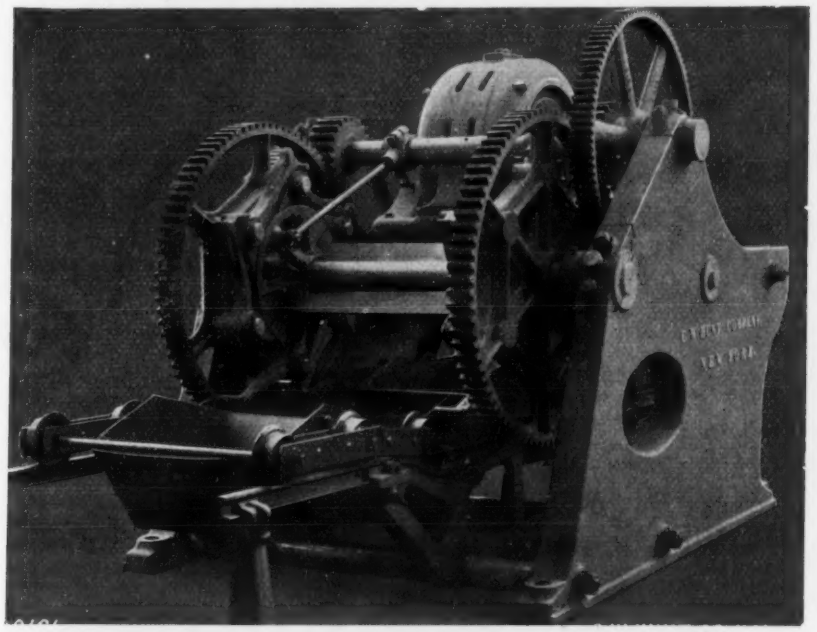


FIG. 2.—ELECTRIC CONVEYOR DRIVER.

The hoist shown is operated by a friction clutch, which is so constructed that no strains exist tending to spread the frames. In other words, the device is self-contained. A differential brake is used, assisting the engineer in its application and requiring very little physical force in its operation to hold and lower the load.

The 20-hp electric conveyor driver built for the Boston Electric Light, Heat & Power Company, and illustrated in Fig. 2, is for driving the company's long conveyor chain. Instead of being driven by sprocket wheels, this conveyor is driven by pawls pushing the chain along, thus entirely obviating the wear of the sprocket wheels and of the chain. The motion is steadier, and permits of the power being applied at any point of the chain, either on a horizontal or vertical line.

NEWS OF THE WEEK.

Financial Intelligence.

THE NEW YORK GAS & ELECTRIC LIGHT, HEAT & POWER COMPANY, which was incorporated at Albany with a capital stock of $25,000,000, has filed a certificate of an increase of capital to $36,000,000.

THE MANHATTAN RAILWAY'S INCREASED CAPITAL.—The State Railroad Commission has approved of the increase in the capital stock of the Manhattan Railway Company from $30,000,000 to $48,000,000. The increase of the stock is to provide funds for the operation of the railway by electric power and otherwise improve the system.

THE EDISON ELECTRIC ILLUMINATING COMPANY, OF NEW YORK.—Mr. R. R. Bowker, who resigned the vice-presidency of this company in December last, has issued a circular to the stockholders opposing the proposition to sell its property to the New York Gas & Electric Light, Heat & Power Company. He figures a $760,000 syndicate profit, and says that the holder of $100 Edison stock would hold no more, or more secure property with $220 in bonds. The plan, he says, seems to be only a method of dilution of stock in which the holder relinquishes any right to increased dividends. The proposition seems to him to present some of the most objectionable features of recent financiering, and loads a thriving business with abnormal fixed charges in bond interest.

Special Correspondence.

New York Notes.

MESSRS. T. F. RYAN and A. N. Brady have been elected directors of the Electric Storage Battery Company of America.

THE METROPOLITAN STREET RAILWAY COMPANY is now running its electric cars from the Sixth and Eighth Avenue lines through to the Battery.

MR. MARTIN J. INSULL, of Chicago, has been in New York for some days past, carrying out important new business arrangements, of which full note will be made later.

MR. JESSE H. BUNNELL, whose death has been noted, leaves, it is stated, about $300,000 of personal estate. Ten per cent. goes to Mrs. Bunnell and the remainder is placed in her hands in trust for the children.

THE AMERICAN DISTRICT TELEGRAPH COMPANY, of this city, it is stated, has been purchased by Mr. Russell Sage and two associates, and the new owners intend to use the company's plant for a new telephone system. According to report, the value of the old company lies in the fact that it has subway rights. The purchase price, it is stated, involves the payment of 3½ or 4 per cent. annual interest on the stock of the American District Telegraph Company.

IT WAS REPORTED during the past week that the contract for the electric motor equipment of the elevated railway had been awarded to the Westinghouse Electric & Manufacturing Company. This, however, was denied by Mr. Russell Sage, who stated that it was the intention of the Manhattan Company to call for separate bids for each branch of the work, and that no one concern would be given the entire contract. No definite time has yet been set for the opening of the bids.

THE NEW YORK GAS & ELECTRIC LIGHT, HEAT & POWER COMPANY, according to a dispatch from Pittsburg, Pa., has effected an arrangement by which the Standard Underground Cable Company will surrender to the first named company $146,000 worth of bonds of the United Electric Light & Power Company, of New York, held by it as collateral. It is stated that the combination of electric lighting interests of New York, as contemplated by the New York Gas & Electric Light, Heat & Power Company, could not be completed without these bonds, and that Mr. George Westinghouse, who is largely interested, has secured the authority to turn the paper over to the combination at actual cost.

ORGANIZATION OF BROOKLYN TROLLEY EMPLOYEES SUGGESTED.—A circular has been sent to the employees of the Brooklyn Heights Railroad Company by President Rossiter and Secretary Williams, in which is suggested the propriety of organizing a mutual aid association among the men. The plan proposed is similar to the organization among the employees of the Metropolitan Street Railway Company in Manhattan Borough, its main objects being to provide a death benefit for the families of the members and pay a sick benefit when an employee is honestly entitled to it. If 500 employees signify their desire to organize such an association an organization will be effected. President Rossiter suggests that $1 a month be deducted from the wages of each employee. The company will give headquarters free of charge, and the management of the association is to be in the hands of five trustees elected by the vote of the members.

THE NEW YORK ELECTRICAL SOCIETY held its 195th meeting in the Engineering Building, Columbia University, on Thursday evening, March 9. A lecture was delivered by Mr. W. J. Jenks on the subject of "Modern Research Into Lightning Phenomena and Building Protection." Mr. Jenks gave a concise review of the facts and theories pertaining to the subject, and illustrated his remarks by lantern slides. He was followed by Mr. A. J. Wurts, who read a paper on "Original Investigation Into the Protection of Electrical Circuits from Lightning," and made some entirely new and important experimental demonstrations. Mr. Wurts considered the charging of overhead wires; the function of the lightning arrester; surging; the principle of the non-arcing direct-current lightning arrester, and of non-arcing metal lightning arresters, and the difference between arcing and non-arcing metals, together with the latest developments in lightning protection practice.

A TWENTY-MINUTE STRIKE ON THE BRIDGE RAILWAY.—The motormen and conductors of the Brooklyn Bridge trains, on the morning of March 1, struck work, and traffic on the railway was, in consequence, suspended for twenty minutes, between 7 and 8 o'clock. The men struck against the enforcement by the Brooklyn Elevated Railroad Company of a new schedule which, they alleged, would have the effect of reducing their wages. Mr. Cornell, general manager of the elevated railroad, stated, however, that the men were mistaken in their interpretation of the schedule, and that it would not diminish their earnings. The trouble was settled by the men agreeing to resume work under the old schedule until the new schedule was modified. At a subsequent conference between the officials of the company and a committee representing the men the new schedule was altered in a manner satisfactory to the men. The motormen and conductors will continue to receive $2,25 and $2 per day, respectively, and a day's work will consist of ten hours on some days and eight on others.

New England Notes.

MR. H. W. SMITH, who has so successfully conducted the railway supply department of the Bibber-White Company, Boston, bade good-by to his numerous friends on Monday, February 27, prior to starting on a six months' trip through the South and West. We predict for him a successful trip from the business standpoint, as the Bibber-White Company presents to the trade only the better quality of electric railway specialties.

THE ELECTRIC CLUB, Boston, held its third annual meeting at the United States Hotel Tuesday evening, February 28. There were about seventy-five persons present. Following the business meeting the club sat down to dinner at 6:30 o'clock and an evening's entertainment, which consisted of brief remarks by W. J. Denver and R. F. Ross, and vocal and instrumental specialties. H. J. Pettingill, the president of the club, presided. The following guests were present at the dinner: E. B. Baker, superintendent of the Southern New England Telephone Company, New Haven; W. J. Denver, assistant general manager, New England Telephone Company; R. F. Ross, New England manager, Electrical World and Electrical Engineer; Capt. William Brophy, chief electrician, City of Boston; S. A. Forrestall, superintendent of telegraphs B. & M. R. R.; J. O. Wright, superintendent New England Telephone Company; William E. Durgin, superintendent Long-Distance Telephone Company, and J. W. Larish, chief electrician Western Union Telegraph Company. At the business meeting the following officers were elected for the ensuing year: President, H. J. Pettingill; vice-presidents, C. E. Bagley, W. E. Durgin, Frank Stevens, Thomas W. Flood; secretary, M. C. Harrington; treasurer, C. H. Hadlock; governing committee, G. H. Yetman, T. J. Villian, H. C. White and E. A. Smith. The important business transacted was with reference to the approaching convention of old-time telegraphers to be held in Boston next September, and it was voted that the president appoint a committee of twenty-five members of the club to arrange a suitable reception and entertainment for this organization.

Southern Notes.

TELEPHONE EXTENSION.—The Orange, Va., Telephone Company contemplates the extension of its line from Parker's Store to Fredericksburg.

LOCAL TELEPHONE SYSTEM FOR DICKSON, TENN.—A project is on foot at Dickson, Tenn., to organize a company of home capitalists for the purpose of establishing a local telephone system. The enterprise is headed by Mr. Pitt Henslee and W. H. McMurray, cashier of the Dickson Bank.

SALE OF TELEPHONE SYSTEM.—The Shreveport, La., Telephone Company has decided to dispose of its plant to the Cumberland Telephone Company. The Shreveport company was considered one of the strongest opposition companies in the country, and its determination to abandon the field comes as a surprise.

A MUNICIPAL PLANT IN NORTH CAROLINA.—The North Carolina legislature has passed a bill empowering the town of Fayetteville to issue

$13,000 bonds for the construction of an electric light plant. The legislature also passed a bill authorizing the town of Tarboro, N. C., to issue $50,000 in bonds for the purpose of building water works and an electric plant.

AGAINST MUNICIPAL OWNERSHIP.—An election was recently held at Fredericksburg, Va., on the question of the city building and operating an electric light plant. The majority vote was against the proposition. It is stated that the next legislature will, however, be asked to grant to the city authority to issue bonds and erect the plant without the sanction of the voters.

ANOTHER TELEPHONE INJUNCTION.—The Equitable Life Assurance Association in Washington has filed suit in equity for an injunction against the Chesapeake & Potomac Telephone Company. The suit is the result of the refusal on the part of the complainant to pay more than $50 annually for the instrument, and the telephone company's threatened removal of the telephone from the insurance company's office.

BUFFALO NOTES.

DEPEW TO BE LIGHTED BY NIAGARA FALLS CURRENT.—The village of Depew, N. Y., has contracted with the Depew & Lancaster Light, Power & Conduit Company for fifty arc lamps to light the streets of the village for a period of five years, from September 1, 1899, with the stipulation that Niagara power is to be used. The above named company has just secured right of way for a transmission line from Depew to Tonawanda, where it will connect with the line of the Cataract Power & Conduit Company.

THE BUFFALO, HAMBURG & AURORA RAILWAY COMPANY has contracted with the Continental Construction Company, of Boston, for the construction of a line from Buffalo to Hamburg and East Aurora, about 28 miles of line in all, to be finished during the current year. Arrangements have been made with the Buffalo Railway Company by which through cars will be run over the latter company's tracks into the business district of Buffalo. The line from Buffalo to Hamburg is expected to be in operation by August next.

CHICAGO NOTE.

"ELECTRIC STREET LIGHTING OF YESTERDAY AND TO-DAY" will be the subject of a paper to be read by Mr. Albert Scheible on the evening of March 17 before the Chicago Electrical Association.

WISCONSIN NOTES.

AN ELECTRIC LIGHT PLANT FOR ELROY.—A stock company is being organized at Elroy, Wis., to establish an electric light plant.

THE WISCONSIN TELEPHONE COMPANY held its annual meeting at the general offices in Milwaukee on February 13. The old directors were re-elected, and officers will be elected at a future meeting.

THE LUCE-VEITCH TELEPHONE COMPANY, at Galesville, which recently went into the hands of a receiver, has been sold at public auction. The property and franchises were bid in by W. P. Veitch for $1,700.

A FRANCHISE has been asked of the Kenosha City Council by Mr. W. H. Scott, superintendent of the Metropolitan Electric Company. Mr. Scott desires to construct and maintain an electric street railway in Kenosha.

THE MILWAUKEE, RACINE & KENOSHA ELECTRIC RAILWAY is now operated by the Milwaukee Electric Railway & Light Company. The original owners of the Racine line were mostly Cleveland capitalists who found that the arrangement by which the line entered Milwaukee from South Milwaukee over the Milwaukee company's tracks was unsatisfactory. The line will be rebuilt, and cars will be uniform with those of the Milwaukee company, and the running time will be shortened.

A NEW ELECTRIC RAILWAY FOR FOND DU LAC.—The Fond du Lac Electric Light Company, whose franchise was renewed for a year from June next, stands ready to build an electric railway during the coming summer. Ample capital has been provided for the enterprise, and Manager Grover is authority for the statement that if the City Council will adopt certain amendments a line will be in operation connecting all the parks and depots with the principal business streets before the summer is over.

CONSOLIDATION IN GREEN BAY.—The final consolidation of the three gas and electric light companies in Green Bay, negotiations for which have been pending for some time, has been completed under the name of the Green Bay Light & Power Company. The three companies are the Fox River Lighting Company, the Green Bay Gas & Electric Light Company and the McCartney Gas & Electric Light Company. The following named officers, it is expected, will be elected: President, William Mainland, of Oshkosh; vice-president, A. M. Sutherland, of New York; secretary, H. Fish, of Green Bay; treasurer and general manager, S. Mainland, of Green Bay.

THE ANNUAL MEETINGS of the Milwaukee Electric Railway & Light Company and the Milwaukee Heat, Light & Traction Company were held in this city on February 20 last. The directors of the first named company were re-elected, as follows: Henry C. Payne, of Milwaukee; Charles W. Wetmore and George R. Sheldon, of New York. Nine directors were elected at the meeting of the Milwaukee Heat, Light & Traction Company. This company is a separate corporation which owns the Wauwatosa line, a wheel within a wheel. These elections make the directors of both companies identical. The officers of the two companies will be elected at a future meeting of the directors.

RAILWAY FRANCHISES IN NEENAH.—After many months of wrangling, the city of Neenah, which has been staving off all official action in granting a franchise to either of the two companies in the field—the Citizens' Traction Company, of Oshkosh, and the Fox River Valley Electric Company—has secured every concession it sought and closed the matter at a special meeting. Contrary to the expectation of the Oshkosh company, the latter re-entered the field after declaring that it was through with the city. The franchises were so constructed that one company promised to do what the other might not do, thus guaranteeing a local system to Neenah, or forfeiting $10,000 in cash for non-compliance.

ST. LOUIS NOTES.

THE MISSOURI TERMINAL RAILWAY.—A charter for a new street railway, the Missouri Terminal Railway Company, of St. Louis, was granted in Jefferson City last week. The capital stock of the company is $75,000.

TAXING POLES AND WIRES.—A bill has been introduced in the Council providing for the taxation of telegraph and telephone companies $2 a year on each pole maintained in the streets, and 10 cents a year for each wire traversing a street or alley in which the wire is carried on housetops and other supports.

AMENDING THE LINDELL COMPANY'S CHARTER.—At a special meeting of the stockholders of the Lindell Railway Company it was decided to amend the company's charter for the purpose of extending its business to the ownership, construction or operation of such line or lines of street railroad in the city or county of St. Louis, in addition to those now owned or operated by the company. This move was made for the purpose of perfecting the consolidation, recently agreed to, in anticipation of the formal transfer of all the Lindell properties to the syndicate represented by the Brown Brothers.

NEW STREET RAILWAY BILLS IN ST. LOUIS.—Three street railroad bills were introduced in the Municipal Assembly last week. One provides for the most extensive franchise that has ever been asked for in St. Louis. It is asked for by the St. Louis Traction Company. The second one provides for the consolidation of the Southern Electric Railway with the Chicago Syndicate lines, and a change of the motive power of the St. Louis Railroad or Broadway line, and other improvements; and the third bill asks for an important extension of the St. Louis & Suburban Railway tracks; also several connections and extensions.

MEXICAN NOTES.

THE DEMAND FOR ELECTRICAL MACHINERY in Mexico is increasing very rapidly. A great deal of this machinery is used in the gold and silver mines throughout the country for lighting and power purposes.

THE ELECTRIC POWER HOUSE of the Federal District Street Railway Company, in the City of Mexico, is almost completed, and the machinery is now being installed. The work of relaying 25 miles of track is progressing slowly.

STREET RAILWAY DEVELOPMENT IN MEXICO.—The improvements and extensions of the street railway systems in many towns and cities of Mexico, now in progress, has led to the placing of some good orders for cars and other equipment with American manufacturers.

ELECTRIC RAILWAY FOR CHIHUAHUA.—The Governor of the State of Chihuahua granted a concession a short time ago to Messrs. F. Sisniega, J. Meyer and S. Arellane for the construction of an electric street railway system in the city of Chihuahua. The holders of the concession are now perfecting arrangements for constructing the system.

CANADIAN NOTES.

THE QUEBEC ELECTRIC RAILWAY COMPANY is busy making arrangements for applying electric power this spring to the entire 60 miles of its road. At present it employs electric power only in the city of Quebec. During the year it is to be applied also to the railway to La Bonne Ste. Anne. The right of way has also been acquired for the new road to be built and operated by the company from Quebec to the Falls of Montmorency, parallel with the turnpike road through the village of Beauport. A good portion of the $1,500,000 of new bonds issued by the company will be used in these works.

AN ELECTRICAL SIREN.—An invention has recently been perfected in Ottawa, by Mr. A. E. Trudeau, which may take the place of electric bells, and will also no doubt be extensively used as a fog signal at sea and along the shores where the fog signals are in use. It can be placed at a point inaccessible to an ordinary steam plant now used in fog signaling, and can be operated by wires connecting the power at almost any distance. The sound is produced by the vibration of a diaphragm at the base of the horn. This new device, it is expected, will be adopted by the Dominion Government to take the place of the rather cumbersome steam plant required for signaling stations.

CANADIAN NIAGARA POWER.—The thirteenth annual report of the Niagara Falls Park Commissioners, which has just been presented to the Ontario Legislature, states that the Canadian Niagara Power Company has installed an electrical plant in the railway power house which will furnish about 1600 electrical horse-power in excess of what is needed for operating the electric railway, of which amount about 600 horse-power has already been put into practical use. The report further says that during the year the commissioners have had under consideration the question of the development of a portion of the water power of the lower rapids of the Niagara for commercial purposes, and the services of Mr. John Kennedy, I. C. E., have been secured to advise the board on the subject. Mr. Kennedy has been engaged during the year in making a study of the peculiar conditions obtaining at several points in the gorge, where it had been suggested that power plants might be placed.

THE METROPOLITAN ELECTRICAL COMPANY, of Ottawa, organized for the purpose of supplying electric light and motive power to Ottawa and the surrounding district, which includes many growing and prosperous towns, has just issued its prospectus to the public. The company has already been incorporated, and the authorized capital stock is placed at $500,000. Thomas Lindsay, of Ottawa, is the president of the company. It is confi-

dently believed that the new company will be successful from the outset, and as Ottawa, with its immense water-power advantages, is fast becoming a chief manufacturing centre of the Dominion, the prospects for future development are exceptionally bright. The company will obtain its water power from the Deschene Rapids, near Britannia, about 6 miles from the city. By estimates obtained from reliable contractors and electrical works in Canada and the United States, the total cost for developing a-5000 hp plant, at this point, fitted with the very latest electrical machinery, with all necessary stations, substations, turbine wheels, generators, transformers, line construction in the city and elsewhere, will be $350,000.

General News.

New Incorporations.

THE EASTERN TELEPHONE COMPANY has been incorporated in East Rochester, Ohio, with a capital stock of $5000.

THE JACKSON UNION TELEPHONE COMPANY has been incorporated with a capital stock of $35,000. The principal office of the new company will be at Anna, Ill.

THE DOVER TELEPHONE COMPANY, Dover, Ill., has been incorporated with an authorized capital of $2000. The incorporators are Charles O. White, M. H. Blackburn and James W. Sabin.

THE VICKSBURG ELECTRICAL SUPPLY COMPANY, Vicksburg, Miss., has been formed with a capital stock of $250,000. Among those interested are M. J. Mulvihill, S. R. Hughes and M. B. Landau.

THE CITIZENS' ELECTRIC LIGHT & MANUFACTURING COMPANY, Nunda, N. Y., has been formed, with a capital stock of $10,000. The incorporators are Marcellus L. Joslyn, E. E. McCullom and E. G. McCullom.

THE SMITHVILLE TELEPHONE COMPANY, Smithville, Tenn., has been incorporated with a capital of $1000, by R. L. Cautrell, T. J. Patten, W. W. Parker, W. B. Parker, D. F. Walker, L. D. Allen, Feli Bradyn, W. L. L. Wilson, Levi Wilson and W. J. Griffith.

THE PHILADELPHIA, MORTON & SWARTHMORE STREET RAILWAY COMPANY has been incorporated with a stock of $100,000. The stockholders are: J. Pareton Lance, William G. Powell, S. Fowler, Henry A. Noble, of Philadelphia, and Ashley R. Shiteyn, of Haddonfield, N. J.

THE MILFORD TELEPHONE COMPANY, Milford, N. Y., has been formed, with the following named directors: George Whitney, C. B. Kinskern and C. A. Carr, Milford; H. E. Kenney, Lee Kenney and George Swarthout, Harwick Seminary, and A. H. Clark, Lily Creek. The purpose of the company is to operate a telephone system from Oneonta to Richfield Springs.

THE MINEOLA, HEMPSTEAD & FREEPORT TRACTION COMPANY has been formed with a capital stock of $125,000. It will construct and operate a street surface railroad 11 miles long. The directors are William J. Newton, B. F. Hamilton, Charles Hills, James A. MacEllinny, P. C. Ackerman, William Meeley and John D. Sweeney, of New York city, and James A. Stiles, of Hempstead. The principal office of the company will be at Freeport, L. I.

The Telegraph and Telephone.

CHICAGO, ILL.—The capital stock of the Illinois Telephone Company is to be increased to $5,000,000, and operations will be commenced at once.

HILLSBORO, KY.—The Home Telephone Company, of this place, has secured a twenty-five-year franchise, and has already commenced operations.

ST. PAUL, MINN.—The Minnesota Legislature has passed a bill placing telegraph and telephone companies under the control of the Railroad Board.

HUBBARD, OHIO.—The Council has granted a franchise to the Union Telephone Company, of Erie, to establish a system in this place. The life of the franchise is twenty-five years.

SPRINGFIELD, MASS.—The Massachusetts Telephone Company will petition the City Council for a franchise. It will make concessions in the way of reduced rates and free service in city departments, including the schools.

COOPERSTOWN, N. Y.—The stockholders of the Susquehanna Valley Telephone Company have decided to extend the line to this city. The extension will take in the towns in the vicinity of the headquarters of the Susquehanna.

DULUTH,MINN.—The Chamber of Commerce has appointed a committee of five to investigate and report upon the feasibility of the construction of a telephone system by the city. It is stated that the mayor is in favor of the scheme.

HAGERSTOWN, MD.—The stockholders of the Maryland Telephone Company have elected the following named officers: President, Claude M. Acklen; vice-president, H. A. McComas; general manager, R. P. Hazlett; treasurer, George Fechtig.

BOSTON, MASS.—The instrument statement of the American Bell Telephone Company for the month ended February 28 shows gross output of 49,263 instruments as against 25,897 during February last year; net output, 35,787 as against 13,107 the same month during the previous year.

DOVER, ILL.—A bill has been introduced in the Legislature to regulate telephone tolls in this State. It provides that no higher rate shall be established than that existing at the present time, and, furthermore, if the present rates are lowered they shall not again be increased. The act is also intended to give telephone subscribers a service in the entire county in which they reside without paying additional tolls.

ALBANY, N. Y.—It is stated that the Merchants' and Manufacturers' Board of Trade will defeat all legislation for cheaper telephone rates this year unless it abandons its efforts to pass the Wagner bill, making a rate of $50 a year for telephone service in New York City. This measure threatens to nullify the work that has been done for several years by the New York Board of Trade and Transportation and by about seventy other organizations all over the State.

WILSON, N. Y.—The Wilson Telephone Company will, in the spring, extend its line to Ransomville, Youngstown, Pekin, Sanburn and other places. Later on connections will be made with Niagara Falls and Lockport and other towns in the county. The rates in Wilson are $5 yer year for the use of a wire, and each subscriber purchases his own telephone outfit, paying therefor $15. The improvements and extension will be under the personal supervision of Superintendent Benjamin A. Stone.

Electric Light and Power.

CHICAGO, ILL.—The Armour elevators have recently added to their electric plant a 30-kw General Electric generator, direct connected to an engine built by the Ball Engine Company, Erie, Pa.

DENVER, COL.—The Arapahoe County Poor Farm will install an electric light plant. The generating outfit will consist of a Westinghouse generator direct-connected to a Ball engine, built by the Ball Engine Company, of Erie, Pa.

UTICA, N. Y.—The Equitable Gas & Electric Company, of this city, has been purchased by New York capitalists who are represented by Mr. Anthony N. Brady, of New York City. The local company is capitalized at $400,000, and furnishes the city with gas and electric light.

CHARLEROI, PA.—The Monongahela Valley Electric Company has let contracts for increasing the 800 horse-power engine capacity in its Speer, Pa., plant. It has also contracted for an additional increase in its electrical equipment of two 3000-light incandescent machines and one 125-light arc-light machine.

PATERSON, N. J.—A combination of gas, electric and power interests has been formed in this city to control all the gas and electric plants in the county and a few of those in Bergen County. All the lighting companies of Paterson, Passaic and Lodi will hereafter be conducted under one management. The United Gas Improvement Company is at the head of the deal, and among the directors are Garret A. Hobart, vice-president of the United States. The capital stock of the new concern is $5,000,000, and bonds to the amount of $5,000,000 will be issued.

TRENTON, N. J.—Consolidation of the electric light and gas interests of this city has been effected. The companies involved in the deal are the Trenton Light & Power Company, the Trenton Gas Light Company, the Peoples Gas Improvement Company, the City Gas Company, the Edison Electric Light & Power Company and the Delaware River Improvement Company. Mr. Henry C. Moore was elected president of the new concern, and Mr. A. R. Kuser secretary and treasurer. The name of the company is the Trenton Gas & Electric Company, and its capital stock is fixed at $2,000,000. The company will erect a new building on East State Street, to cost about $20,000.

SCRANTON, PA.—It is rumored here that the Electric Company of America proposes to establish here a large plant containing modern machinery for the purpose of generating electric current to be transmitted to Philadelphia and New York. The first step in the development of the plans is the reported purchase of some 400 acres of coal land in the vicinity of Scranton, for about $350,000. The cost of fuel, it is said, will be reduced to almost nothing by the use of culm—the waste of the anthracite coal—which is piled in huge banks all over the property. It is estimated that there are 1,500,000 tons of it on the site. This culm, it is stated, costs the company only 20 cents a ton, a sum which makes the expense of producing power very small.

The Electric Railway.

RICHMOND, IND.—There is some talk of building a trolley line from Richmond to Cincinnati by way of several intervening towns.

SAGINAW, MICH.—An order has been filed for the discharge of the receivers of the Consolidated and Union Street Railway companies.

GENEVA, OHIO.—The Pennsylvania & Ohio Electric Railway Company has been granted a franchise to build its track through this place.

ELGIN, ILL.—It is stated that the electric railway running from Aurora to Carpentersville will in the spring be extended to Algonquin, 10 miles north of Elgin.

DOYLESTOWN, PA.—The Quakertown Traction Company has been granted the right by the Doylestown Borough Trustees to construct and operate an electric road in Doylestown Borough.

NORTHAMPTON, MASS.—The Railroad Commissioners have granted a charter to the Northampton & Amherst Street Railway Company, which has just been organized with a capital stock of $150,000.

WAUKEGAN, ILL.—The Chicago & Milwaukee Electric Railway Company is making preparations to finish its line south from Highland Park to Evanston. The work will be carried on during the summer.

AUBURN, N. Y.—The Auburn & Interurban Electric Railroad Company will extend its lines from Auburn to Syracuse by way of Skaneateles. The Interurban company is practically controlled by the Auburn railway.

DAYTON, OHIO.—The Dayton, Springfield & Urbana Traction Company has given the Continental Trust Company of New York a mortgage and trust deed for $750,000. The instrument covers the entire plant and equipment.

IRONTON, OHIO.—Mr. Edward L. Wilson has been appointed receiver of the Ironton Electric Light & Street Railway Company in the foreclosure case of the Knickerbocker Trust Company. His bond was fixed at $25,000.

CLEVELAND, OHIO.—The Cleveland & Akron Suburban Electric Railway Company, successors to the Cleveland & Southeastern Electric Railway Company, has been granted an extension of franchise, until July 1, 1899, by which date the construction work is to begin.

ATLANTA, GA.—The Atlanta Street Railway Company has awarded contracts for building 10½ miles and reconstructing 16½ miles of track in Atlanta, Ga., to David E. Evans & Co., of Baltimore, Md. Other bidders were J. G. White & Co., Baltimore, and the Electrical Installation Company, Chicago.

ANSONIA, CONN.—A company has been organized with a capital stock of $50,000 to build and operate an electric railway line from Woodbury to Waterbury by way of Hotchkissville, Southbury and Watertown, the total length being 15 miles. Judge James Huntington, of Woodbury, is president, and Edwin S. Boyd is treasurer.

KANSAS CITY, MO.—It is proposed to build an electric railway from Carrollton, Mo., to Waverly and across the river to Higginsville. The merchants of Carrollton have organized to advance the project and those of the other towns are being interested in the scheme. It is stated that the project is meeting with favor and that the road will be built.

ELYRIA, OHIO.—The County Commissioners have granted a franchise to the Lorain County Railway Company to use such highways between the towns of Lorain and North Amherst that may be needed for the building of an electric road between those two points, Most of the line will occupy private right of way, which, it is stated, has already been secured.

FRANKFORT, KY.—The Court of Appeals has affirmed the judgment of the State Fiscal Court in the case of the Louisville Railway Company against the commonwealth, holding that the State Board of Valuation fixed the valuation of franchises on a fair cash basis, or 100 per cent., instead of 70 per cent., as contended by the street railway company. The suit was for franchise taxes for 1896, involving about $27,000.

CHESTER, PA.—The single word "One" displayed in the office window of the Chester Traction Company, of this city, has excited considerable curiosity among those who have noticed it from day to day. During the colder weather the word "Two" was displayed. Inquiry as to the meaning of these signs shows that they are notices to the conductors of the passing cars to turn their heater switches one point or two points, according to the temperature of the atmosphere outdoors.

NEENAH, WIS.—The City Council has granted a franchise to Mr. E. E. Downs, president of the Citizens' Traction Company, of Oshkosh, Wis., to construct a street railway in this city to connect with the proposed interurban railroad which is to be built between this city and Oshkosh. A franchise was also granted to the Fox River Valley Interurban Company to construct a line from its terminal in this city to Riverside Park. Both franchises are for twenty-five years, and both lines are compelled to accept transfers at one fare rate. The roads are to be finished before September 1 next.

LEBANON, PA.—The Lebanon & Annville and Lebanon & Myerstown Electric Street Railway Companies have been consolidated and the system will be extended and improved. President S. P. Light says that the first thing to be done will be the erection of a new and modern power house. This work will be undertaken in the spring, and at the same time all the city lines will be rebuilt in the most improved style. The Annville line will be extended westward to Palmyra during the summer. The entire length of the lines of the system will be 37 miles. The officers of the new company are: President, Simon P. Light; secretary, Harry H. Light; treasurer, Frank H. Reinoehl.

SEATTLE, WASH.—It is stated that a deal is under way having for its purpose the consolidation of the street railways of Seattle and Tacoma, and that there is a fair prospect of its consummation. The scheme contemplates the incorporation of the Cedar River Water Power Company and an electric road connecting the two cities. Mr. Malcolm McDougall, of White River, who is interested in the project, was recently granted a franchise for a road through King County, and now has an application for the Pierce County and Tacoma portion of the proposed line. The Cedar River proposition pertains simply to power, it being proposed to secure sufficient power from the concern to operate all the roads of Tacoma and Seattle.

CHICAGO, ILL.—Two companies have been incorporated at Springfield to construct and operate two electric roads, one from Chicago to Aurora and the other from Chicago to Elgin. The names of the companies are the Aurora & Chicago Railway Company and the Elgin & Chicago Railway Company, each having a capital of $300,000. The incorporators of each are B. Mahler, president of the Lorain & Cleveland Railroad Company; H. A. Everett, president of the Akron, Bedford & Cleveland Railroad Company; C. W. Moore, of Cleveland; Elmer E. Barrett, of Chicago, and Edward Dickinson, of Chicago. It is stated that the work of construction will begin at once. The new companies, it is reported, are buying up private rights of way, which will be fenced in, and it is proposed to operate the trains at a maximum speed of 45 miles per hour.

ALBANY, N. Y.—The Albany Railroad Company has received one of the ten new cars which were designed by Assistant General Manager E. P. Fassett, and which are to be built by J. M. Jones & Son, of Watervliet, N. Y. The car is a new departure in electric cars. It is a combination smoker and ladies' car, with elaborate interior decorations. It is 40 feet long on the outside and has an enclosed space for passengers of about 34 feet. The spring seats are covered with woven split cane and are arranged as in an ordinary railroad coach, the aisle being in the centre. The smoking compartment, in which the seats run lengthwise, has unusually large plate-glass windows, which in summer can be dropped sufficiently to make, to all intents and purposes, an open car. The car is equipped with the Taylor double-truck and Westinghouse motors. As soons as all the cars have been received they will be placed on the Troy division of the road, which will probably be about the latter part of June.

GRAND RAPIDS, MICH.—The Grand Rapids, Grand Haven & Western Railway is the name of an interurban electric line which is to be built between this city and Grand Haven. It is stated that the work on the line will be commenced as soon as the franchises have been put in proper shape. The Grand Haven City Council has granted the company the right of way through the city, and it is stated that the people along the proposed route are heartily in favor of the building of the road. The power house of the company will be located at either Coopersville or Lamont, and freight as well as passengers will be carried. It is stated that the company will have railway trucks constructed and special wagons built, so that the latter can be placed on the trucks and hauled from point to point on the road. The wagons, on reaching their destination, are run off the trucks without the necessity of disturbing the freight, and drawn by horses to their final destination. It is stated that the company will make arrangements with the Consolidated Street Railway Company to enter this city. If such an arrangement cannot be effected the Common Council will be asked for a franchise and an independent line will be built.

LEGAL NOTE.

INCREASING LIABILITY OF EMPLOYERS.—The liability of employers is under consideration by the courts very frequently. Many of the numerous cases introduce new and novel points for decision, and apparently with the introduction and general use of electricity the tendency is growing in our courts and legislatures to increase the liability of employers and hold them responsible for about all the accidents possible or incident to the occupation of their employees. On this account injured employees are encouraged to more emphatically enforce claims for damages. The latest efforts in the direction of incrasing the liability of employers to their employees is manifest by the introduction of bills in the New York and Indiana legislatures. The New York bill provides that in case of accidental death or injury of an employee the employer shall be liable in damages, if the accident resulted by reason of any defect in the condition of the place of employment; negligence of any person in the service of the employer intrusted with or exercising superintendence; negligence of any person in the service of the employer who has charge of any signal point, telegraph office, switch, switch-yard, shop, locomotive engine, car, round-house, train or electric motor or plant; the act or omission of any person in the service of the employer done or made in obedience to the rules or by-laws of the employer; failure of the employer, his agents or representatives, to enforce or comply with the terms of the requirements of the general labor law of the State; failure of the employer, or of any person having power or authority to act for the employer, to exercise due care in selecting competent and proper employees, or to select or apply proper and sufficient tools, implements or appliances. The Indiana bill, which has become a law, deals with the question of contributory negligence. It provides that no presumption shall be indulged that an employee or complainant was negligent from the fact that he was injured; that the burden is on the employer or defendant to show contributory negligence in the employee or complainant; that an employee or complainant may recover damages when the employer's or defendant's negligence is only one of several contributing causes. These bills are far-reaching and will be effective. Negligence, like fraud, is wrong, and should not be imputed to either employee or employer. From the number of substantial judgments recovered by employees it would seem that they have had fair protection under present laws, but these two States have provided additional ease to secure damages. An employer may, perhaps, in time be permitted to breathe without breaking a law or running up against a liability act, but that time seems to be remote.

PERSONAL NOTE.

MR. E. T. GIBBON has resigned his position as superintendent of the Corpus Christi Electric Company, Corpus Christi, Tex., to accept a like position with the Beaumont Ice, Light & Refrigerating Company, at Beaumont, Tex.

Trade and Industrial Notes.

THE PENNSYLVANIA ELECTRIC COMPANY has moved its office from Marietta, Pa., to Lancaster, Pa.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., has increased its capital stock from $100,000 to $125,000.

MR. M. I. VOUGHT, dealer in electrical supplies, La Crosse, Wis., has moved into more commodious quarters, and extended his business. His address is now 123-125 South Second Street.

THE BALL ENGINE COMPANY, Erie, Pa., has recently furnished two of its engines to be direct connected to 65-kw generators for installation in the works of the Toledo Glass Company, Toledo, Ohio.

MESSRS. EUGENE MUNSELL & CO., of New York and Chicago, are ready at all times to supply street railways and manufacturers of electrical apparatus with India and amber mica for electrical insulation.

THE ATLANTIC MANUFACTURING COMPANY, which was recently incorporated in Maine by Mr. Chas. E. Bibber and others, is putting up a factory in Mansfield, Mass., where it will manufacture a line of electrical specialties.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, according to a Pittsburg dispatch, has received contracts for car equipments and machinery for the motive power for an electric railroad in Rouen, France.

THE W. J. JOHNSTON COMPANY announces the sale of Johnston's Electrical & Street Railway Directory to Mr. E. L. Powers, 150 Nassau Street, New York, to whom all communications on the subject should now be addressed.

THE FORT WAYNE ELECTRIC CORPORATION has been placed in the hands of Messrs. C. H. Worden, president of the corporation, and S. L. Morris as receivers. The receivers will continue to operate the works, but will reduce the force if possible.

THE UNITED STATES NAVAL STATION AT BREMERTON, WASH., is installing a direct-connected combination consisting of two 50-kw General Electric generators and a tandem compound condensing engine built by the Ball Engine Company, of Erie, Pa.

MESSRS. ROYCE & MAREAN, 1423 New York Avenue, Washington, D. C., have sold their entire stock of electrical goods to the National Electrical Supply Company. The new company will continue the business at the old address of the firm which it succeeds.

THE ALLEN HUSSEY COMPANY, manufacturer, wholesale dealer in and contractor for interior telephone systems, 211-213 Randolph Street, Chicago, has opened an office at 101 Beekman Street, New York City. Mr. W. R. Allen, of the company, will reside permanently in New York and take full charge of the company's Eastern business.

THE KESTER ELECTRIC MANUFACTURING COMPANY was recently incorporated by Messrs. J. F. Kester, president; W. L. Cadle, treasurer, and J. H. McGrew, secretary. The headquarters of the company are at 241 South Jefferson Street, Chicago. The company will manufacture a line of electric light and power station supplies.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., states that it is selling large quantities of a very compact form of rheostat for small ventilating fan motors, in which the wires are enameled upon the surface of a small pottery tube. This, it is stated, makes a very simple, compact and permanent form of resistance, and the cost is surprisingly low.

THE FULLER COMPANY, Detroit, Mich., has just closed contracts for the electrical equipment of two large freight steamers and one fine passenger steamer for service on the great lakes. It is operating its factory well into each night, and reports now having orders on its books more than one-half greater than the entire business done by the company during the past year.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is out with its 1899 catalogue of fan motors and ceiling fans for the alternating current. It gives complete descriptions of both these classes of fans, as to their mechanical construction, and diagrams and illustrations show various details and the machines complete. A telegraph code is given at the back.

THE STERLING ELECTRIC COMPANY, of Chicago, closed its first year's business with the month of February. During the past month it has doubled its machinery plant. This company has been working two shifts of men night and day for the past thirty days, and Manager Doolittle states that it will continue doing so for the next three months in order to fill the accepted orders.

MESSRS. PRESTON, COHEN & CO., Philadelphia, have opened an office at 1004 Real Estate Trust Building, where they will represent manufacturers of electrical and street railway supplies. They have made arrangements to handle the goods of some of the leading manufacturers in the country. The new firm has excellent facilities for carrying on business in this line, and there is every promise that it will make a success of its enterprise.

THE CENTRAL ELECTRIC COMPANY, Chicago, is about to make extensive alterations to accommodate the increased office force rendered necessary by its growing business. It says that whether March "comes in like a lion and goes out like a lamb" or the animal processional is reversed, the season of 1899, like the company's twentieth century catalogue, will be a record breaker, if the spring trade is any forerunner of later conditions.

BUSINESS CHANGE.—The electrical supply business, which has been conducted by Messrs. J. A. Erner & Co., at 354 North High Street, Columbus, Ohio, will in the future be carried on under the firm name of Erner & Hopkins, Mr. W. A. Hopkins, Jr., having purchased an interest. Mr. Hopkins has been identified with Mr. Erner since the business was commenced. The construction work will be continued under the firm name of the J. A. Erner Construction Company.

THE STOCKHOLDERS OF THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., will hold a meeting on May 1 for the purpose of considering a proposition to increase the capital stock from $1,000,000 to $1,500,000, in order to provide for the purchase of a site and the erection of a new plant, with double the capacity of the present works. The present plant, it is stated, has become too small for the business of the company, and larger quarters are necessary.

"THE PREVENTION OF FIRES DUE TO LEAKAGE OF ELECTRICITY" is the title of a paper read by Mr. Frederick Bathurst before the Society of Arts, London, England, for which the author received the Fothergill prize. The paper has been reprinted in pamphlet form. The author endeavors to point out the direction in which improvement can be made in the way of avoiding fires caused by defective electric wiring. The paper makes a strong plea in favor of insulated tubing to accomplish the desired object.

THE MONTAUK MULTIPHASE CABLE COMPANY, 100 Broadway, New York, has just published an artistically gotten up little pamphlet in which considerable interesting information is given concerning the applications of multiphase cables. The principles of construction of the cable are pointed out, and the advantages of its use are presented in a very convincing manner. This cable is approved by leading electrical experts, leading fire departments, leading municipal fire alarm systems, and is rapidly coming into general use.

THE SPRAGUE ELECTRIC COMPANY has issued for February a very handsome edition of its "Architect's and Engineer's Electrical Bulletin," a magazine of 50 quarto pages, with advertising, and a cover in green, red and gold. It has been compiled in masterly fashion, and contains several valuable illustrated articles and papers, by Messrs. E. H. Johnson, Robert Lundell and other officials or experts of the company. Views of new apparatus are given, as well as numerous pictures of recent office buildings supplied with Sprague electric elevators.

THE ANCHOR ELECTRIC COMPANY, 71 Federal Street, Boston, Mass., has gotten up a very handy leather-covered pocket diary. Among its features is a Diamond atlas of the United States, giving maps of the different sections of the country, also a list of 1800 names of places in the United States, including Alaska and Cuba, with keys for their location on the maps. There is a memoranda space for each day of the year, and considerable information of an electrical nature, all of which should be very useful to anyone in possession of a copy of this little book.

"WHEN THE MOTOR CAR DISPLACES THE HORSE" is the title of an interesting illustrated article in the Buffalo "Express" of February 26. These vehicles are referred to as prospective conveyances to the Pan-American Exposition. Illustrations are given of a hooded phaeton for two persons and an automobile brougham made by the Fischer Equipment Company, Chicago; an electric park wagon manufactured by the American Electric Vehicle Company, of Chicago; and a Columbia motor carrier and a Columbia motor surrey made by the Pope Manufacturing Company, Hartford, Conn.

THE GENERAL ELECTRIC AUTOMOBILE COMPANY, of Philadelphia, has been reorganized recently and it is the company's intention to actively push for business in its particular line. A number of Philadelphia and New York capitalists are interested in the enterprise. The company now controls by ownership seventy patents, covering practically all of the devices and appliances of value entering into the construction of electrically propelled vehicles, as well as various other applications of electrical energy. It has a complete manufacturing plant, with every facility for producing electric vehicles of every description.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., is offering to the trade, in connection with its large assortment of telephone supplies, the Moon terminal head, or distributing box. This device has been designed to meet the objections met with in the use of some other makes of distributing boxes. One of its principal features is the arrangement of the fuse connection, which takes a fuse 3½ inches long, although the distance between the terminals is only one inch. The company has sold a great many of these terminal boxes in the West and Southwest, and states that they have given excellent satisfaction wherever they are used. They are fully described in the company's No. 18 telephone catalogue, a copy of which may be had on application.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Ia., has just issued its 1899 catalogue of the improved Garton lightning arresters. The statement is made that lightning has no terrors for users of Garton lightning arresters. This is a bold assertion to put forward, but since the Garton-Daniels Company has been making these lightning arresters for many years, and has been doing a good business with them, it is reasonable to suppose that it has some justification in fact. In the catalogue are discussed the requirements of a reliable lightning arrester, and the advantages of the Garton instruments are very clearly illustrated and set forth. These instruments are designed for electric light, power and railway circuits of any voltage, direct or alternating current. Diagrams show the method of connecting the instruments to the lines and the various instruments themselves. The company's products embody an experience of six years.

MESSRS. J. C. STERNS & CO., 225 Pearl Street, Buffalo, N. Y., report having closed contracts during the past twenty days for electrical apparatus as follows: The William Hengerer Company, department store, Buffalo, one 30-hp, 110-volt, standard-speed Westinghouse multipolar motor; G. Elias & Bro., planing mill, Buffalo, one 17½-kw. 110-volt, standard-speed Westinghouse multipolar generator; Buffalo Cold Storage Company, one 20-hp slow-speed, 500-volt, Westinghouse multipolar motor, also one 30-hp, 500-volt Westinghouse multipolar motor; the Taylor building, Buffalo, one 8½-kw standard-speed, 110-volt Westinghouse multipolar generator; Spencer Kellogg, Buffalo, one 30-kw, 125-volt, direct-connected Westinghouse multipolar generator; Buffalo Smelting Works (Calumet & Hecla Copper Company's smelter), one 5-hp, 220-volt, standard-speed Westinghouse multipolar motor, and one 3½-hp, 220-volt Westinghouse slow-speed multipolar motor; American Malting Company (Curtiss malt house), one 17½-kw, standard-speed Westinghouse 110-volt multipolar generator.

INDEPENDENT TELEPHONE SERVICE IN MICHIGAN.—A notable illustration of the education of the public to the use of the telephone is furnished by the Valley Telephone Company, operating exchanges in Saginaw East, Saginaw West, Bay City, West Bay City, and Flint, Mich. The exchanges of this company, which were opened for business in August, 1898, are equipped with the apparatus of the Sterling Electric Company, of Chicago. Owing to the constant and rapid increase in the number of subscribers and the amount of trunking business between the different cities during six months' service, the Valley company has found its present equipment inadequate to handle the business, and has given the Sterling Electric Company the order to design and furnish additional special equipment which is to be installed in the exchanges named during the next thirty days. These improvements will enable the telephone company to properly handle its increasing business, and at the same time give it one of the best telephone systems in the country. It is stated that the operators of this company are called upon to make more connections per hour each day than in any other exchange in the State of Michigan.

ELECTRICAL EDUCATION in the hands of The Electrical Engineer Institute of Correspondence Instruction has proved a remarkable success, from whatever standpoint it is regarded. A recent announcement of the Institute sums up clearly and pertinently the scope of its work, giving the names of twenty well-known men who have prepared its literature and lessons, and enumerating the twenty separate technical courses that it already provides in electricity. As to indorsements, they are legion, and of the character of that given by Mr. Edison himself, who as a personal friend of the founders of the Institute takes great interest in their efforts. The excellent little brochure issued by the Institute, "Can I Become an Electrical Engineer?" is now very familiar, and has just been supplemented by an admirable and dainty book from the facile pen of Mr. H. A. Strauss, the secretary and general manager of the Institute, entitled "The Electrical Marvels of Our Times." It is a fascinating bit of literature, and cannot but stimulate the general desire to form an intelligent acquaintance with the great art of electricity. The Institute, which was organized under the auspices of "The Electrical Engineer," maintains large offices at 120 Liberty Street, New York, where it will be glad to receive callers and inquiries. Its mail already encircles the globe, and its pleased students are everywhere.

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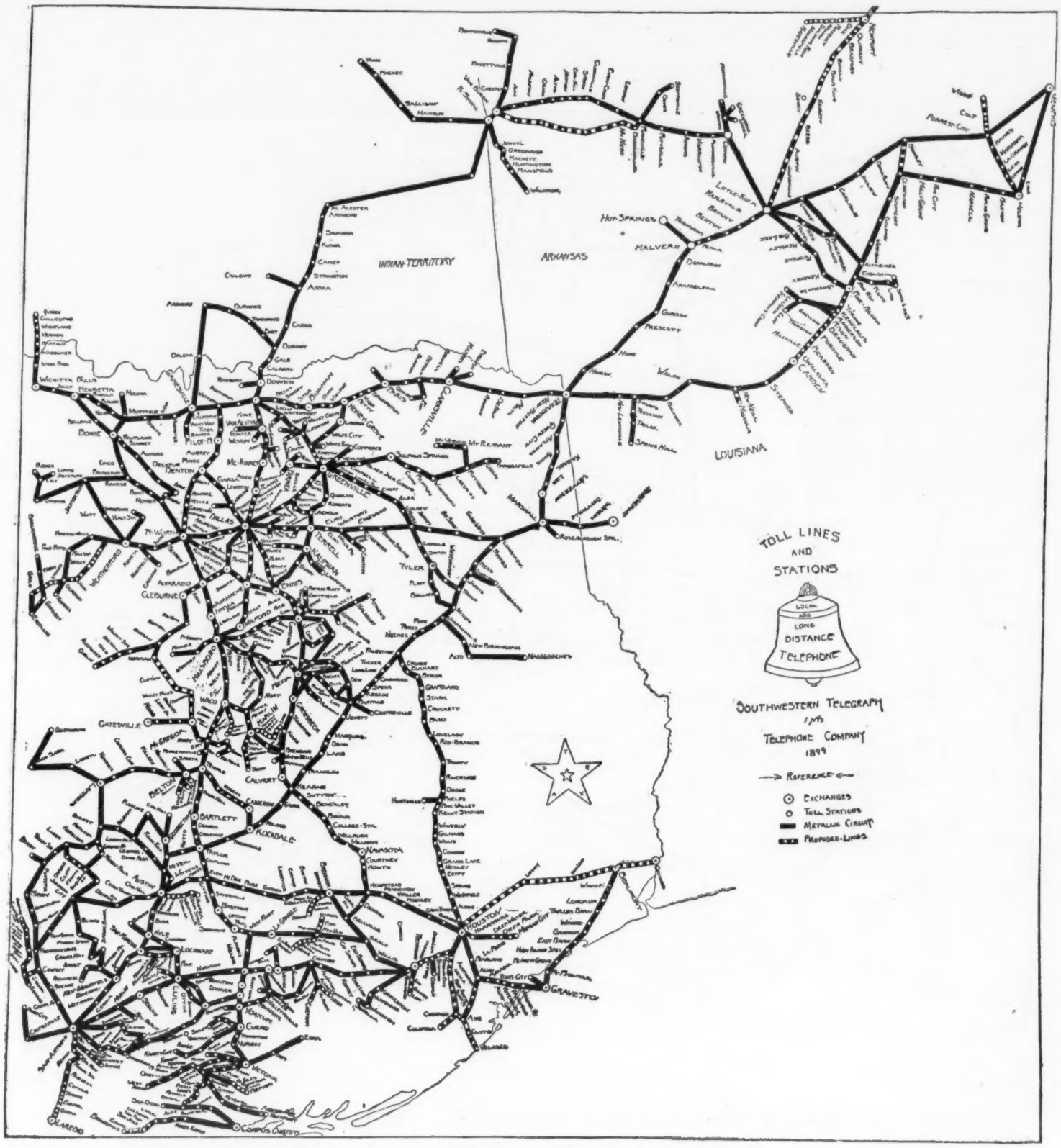

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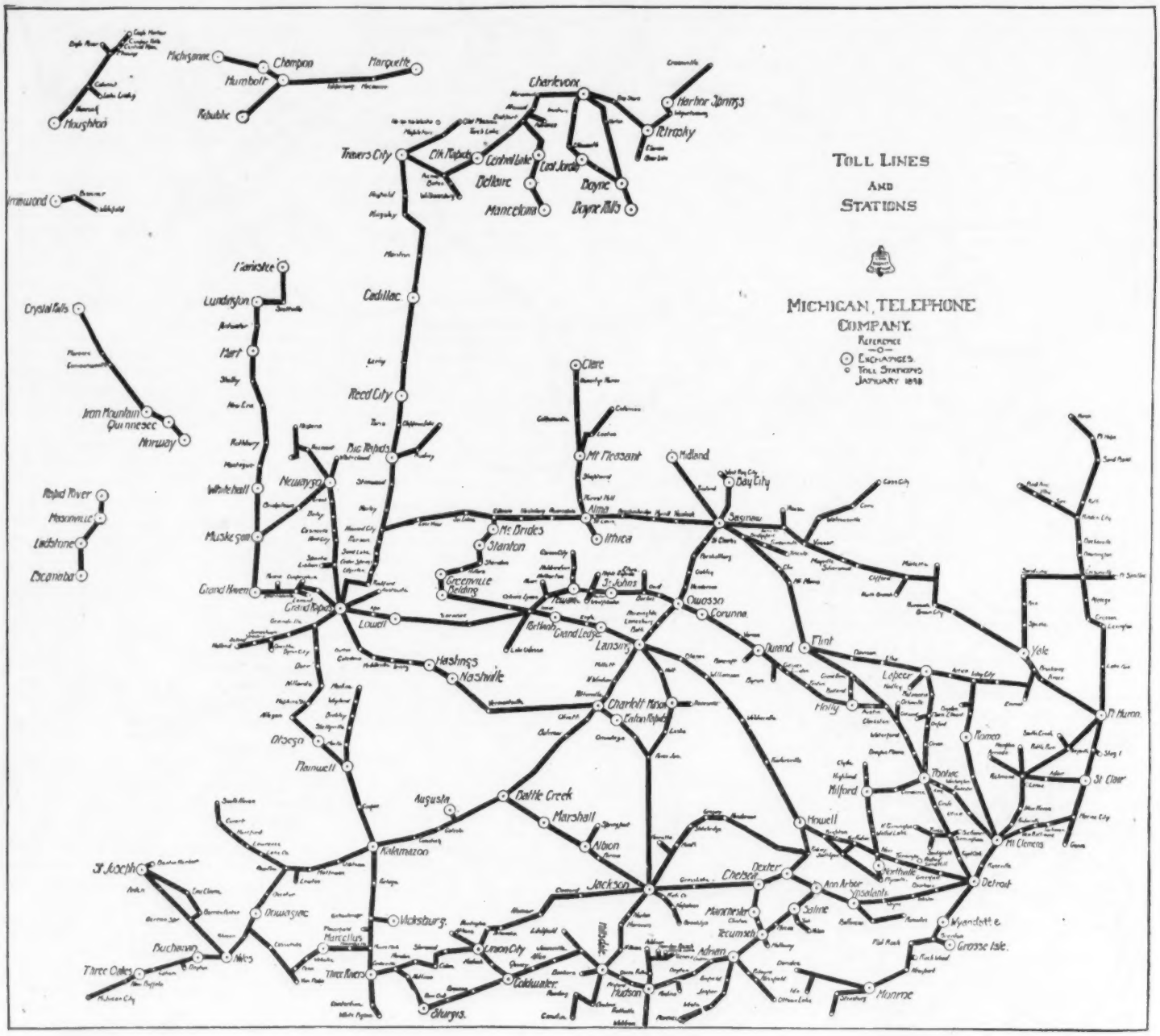

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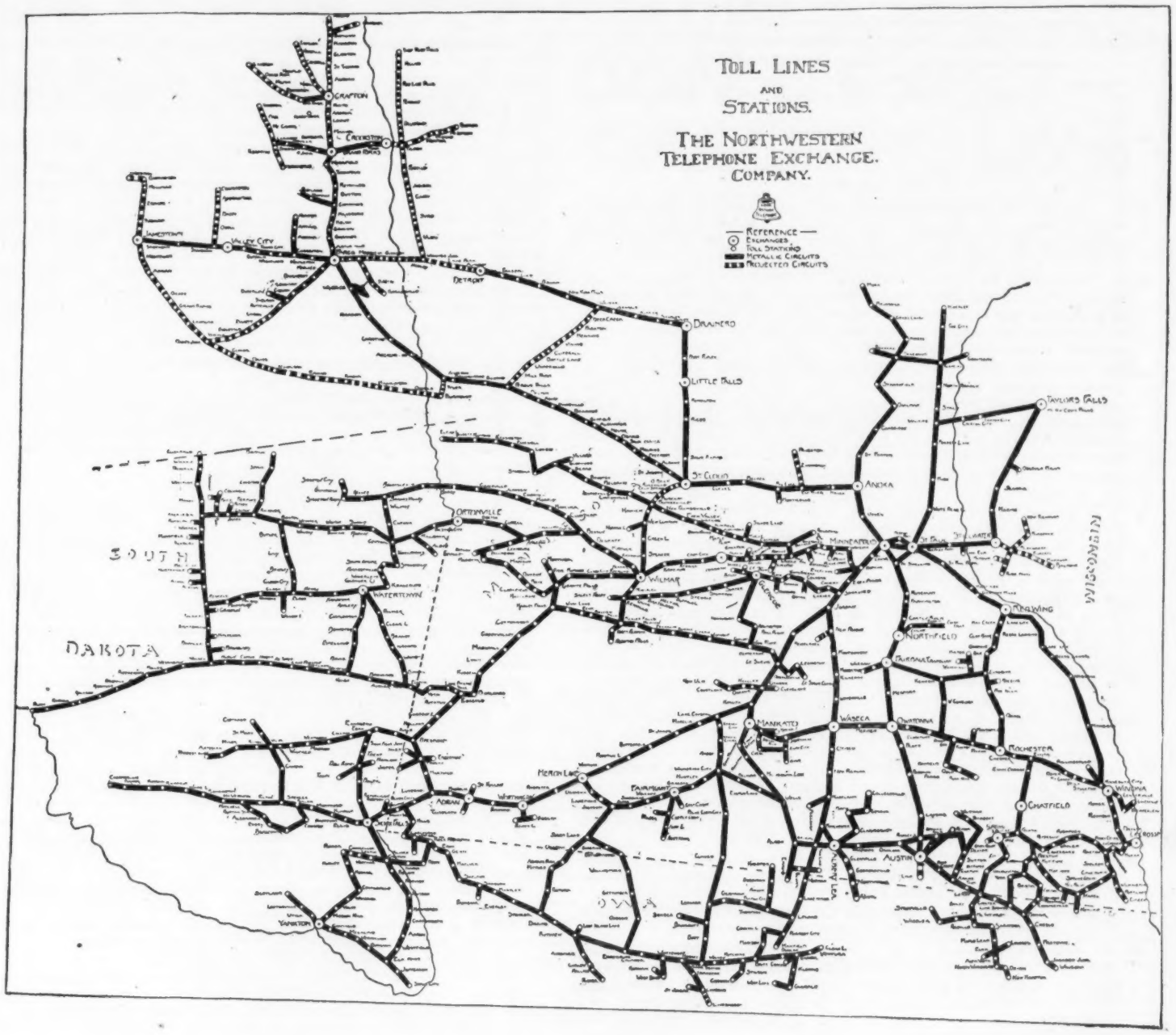

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Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 28, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

620,111. CUT-OUT; E. Ellicott, of Chicago, Ill. App. filed December 30, 1897. As a new article of manufacture, an electric line-terminal consisting of a rounded lug adapted to be secured to an insulating base-plate, a terminal portion provided with a receptacle for the connected conductor, and a sleeve rotatably fitting upon said lug and adapted to be secured in position thereon.

620,117. ARC-LAMP FOR ELECTRIC LIGHTING; D. Gertin, of Corning, N. Y. App. filed September 15, 1898. In an arc-lamp, a globe or envelope for the arc closed at the bottom and having a restricted orifice in its peripheral walls for the admission of air below the arc and a passage above the arc for the escape of the gaseous products of the arc.

620,144. MULTIPHASE-CURRENT TRANSFORMER; E. L. K. F. Kahlenberg, of Berlin, Germany. App. filed August 8, 1898. The combination with a source of multiphase current of a transformer for supplying secondary circuits and having multiphase windings and automatic means for connecting windings of the transformer either in star or triangle fashion, substantially as described.

620,172. SECONDARY BATTERY; G. Philippart, of Paris, France. App. filed March 22, 1898. An electrode comprising a conductor of active material and surrounding sleeve composed of superposed washers of ribbed or corrugated material, substantially as described.

620,214. CARBON-HOLDER FOR ELECTRIC ARC LAMPS; S. Bergmann, of New York, N. Y. App. filed January 24, 1898. The combination with a guiding tube for a carbon of an electric arc lamp of a carbon holder provided with a seat, balls and weight, substantially as described.

620,254. FOOT-TUB ELECTRIC BATH; C. H. Schnee, of Carlsbad, Austria-Hungary. App. filed December 15, 1898. A bathing apparatus consisting of a chair having a vertically and laterally adjustable seat, vertically and laterally adjustable revolvable side rests, arm-tubs supported thereon, and foot-tubs, substantially as described.

620,283. REGULATING TRANSFORMER; E. W. Cowan and A. Still, of Bowdon, England. App. filed December 29, 1897. A regulating transformer comprising a fixed portion forming part of an iron circuit and a movable portion forming the remaining part of said circuit, a primary winding, a secondary winding partly on the fixed and partly on the movable part, and short-circuiting or shading coils of low resistance arranged with their axes transversely to the winding of the primary coil, substantially as described.

620,302. AUTOMATIC CUT-OUT FOR ELECTRICAL TRANSFORMERS; W. J. Greene, of Cedar Rapids, Iowa. App. filed October 11, 1897. In an automatic cut-out for electrical transformers, the combination of terminal plates, to which the conducting wires are attached, removable mercury-cups resting on said plates, and switch terminals adapted to dip into said cups, and provided with sealing gaskets of elastic material, as cork.

620,306. ELECTRICALLY-HEATED TOOL; W. S. Hadaway, Jr., of New York, N. Y. App. filed January 26, 1898. In an electrically heated tool having a heater-body and an electrode adjustable to and from the same to form an arc, the combination, with the body and the electrode, of a sleeve of refractory insulating material surrounding the electrode adjacent to the arc, such sleeve serving to insulate the electrode and support it movably adjacent to the body.

620,307. PROCESS OF FORMING MAGNESIA INSULATION UPON CONDUCTORS; W. S. Hadaway, Jr., of New York, N. Y. App. filed January 26, 1898. The process of coating electric wire with an insulation of magnesia for use in electric heaters, which consists in first coating the wire with metallic magnesium, second, applying manganese oxide in a paste to such coating of magnesium, and third, placing a heated mass about the wire to decompose the manganese oxide and thus oxidize the magnesium upon the wire.

620,308. INCANDESCENT ARC LIGHT; W. S. Hadaway, Jr., of New York, N. Y. App. filed February 16, 1898. In an arc-light, the combination with the carbon pencils, of a refractory shell fitted close to the carbons about the arc to be heated thereby, and provided with a projection or projections to diffuse the light when the shell is incandescent.

620,309. ELECTRIC FUSE; W. S. Hadaway, Jr., of New York, N. Y. App. filed April 27, 1898. In an electric fuse, a magnesium wire or strip employed to conduct and to break the current, and adapted to oxidize below the point of fusion, and thus forming an infusible conductor under such conditions.

620,319. AUTOMATIC INDICATING DROP FOR ANNUNCIATORS; J. Hewitt and Charles Gapen, of Pittsburg, Pa. App. filed May 3, 1898. In an automatic annunciator drop, the combination of a base portion having suitably arranged thereon a series of electromagnets, tilting bars, armatures formed integral with one end of said bars and indicating tags or plates formed integral near the opposite end thereof, an automatic holding or locking bar pivotally secured in a pair of supporting brackets mounted on the base portion, and a series of supporting extensions formed integral with said automatic holding or locking bar, substantially as described.

620,326. ELECTRIC RECORDING APPARATUS; C. L. Jaeger, of New York, N. Y. App. filed April 19, 1898. In a recording system, the combination of a series of contacts and a conductor arranged to move relatively to each other but not placed in actual contact, a recording device comprising a second series of contacts corresponding to the first series of contacts and electrically connected with the same, a conductor arranged adjacent to said second series of contacts, but not in actual contact with the same, a spark-producing device, electrical connections between said device and the conductors and contacts and means for feeding record papers between both series of contacts and their corresponding conductors; all constructed and arranged to form perforations in the record-papers, substantially as described.

620,327. ELECTRIC RECORDING SYSTEM; C. L. Jaeger, of Maywood, N. J. App. filed August 11, 1898. In an electric recording apparatus, the combination of a movable body made of non-conducting material and provided with an opening or slot permitting the passage of sparks, means for moving a strip or chart, means for producing sparks and electrical connections, substantially as described.

620,333. DIRECT-CURRENT MOTOR AND METHOD OF OPERATING SAME; B. G. Lamme, of Pittsburg, Pa. App. filed December 16, 1897. The method of increasing the speed of a direct-current motor, provided with collecting rings and with co-operating brushes connected through an autotransformer which consists in reducing the counter electromotive force by transferring one of the supply-circuit connections from a commutator-brush to the middle point of the transformer-winding.

620,334. DIRECT-CURRENT SYSTEM OF ELECTRICAL DISTRIBUTION; B. G. Lamme, of Pittsburg, Pa. App. filed August 4, 1898. In a system of electrical distribution, the combination with a direct-current generator, of feeding-conductors connected to the generator in the usual manner, a shunt to the series winding of the generator and a pair of feeding-conductors one of which is connected to substantially the middle point of said shunt and the other to one of the terminals of the generator.

620,335. METHOD OF AND MEANS FOR VARYING SPEED OF DIRECT-CURRENT MOTORS; B. G. Lamme, of Pittsburg, Pa. App. filed September 3, 1898. The method of varying the speed of a direct-current electric motor which consists in varying the self-induction of the armature circuit and thereby varying the armature reaction.

620,336. SYSTEM OF ELECTRICAL DISTRIBUTION AND REGULATION; B. G. Lamme, of Pittsburg, Pa. App. filed September 28, 1898. The method of governing the speed of a rotary transformer employed for transforming direct currents to alternating currents, which consists in subjecting the alternating current or currents to differential or compensating reactive forces so proportioned as to maintain a subbstantially constant armature reaction in the transformer.

620,343. ROTARY-TRANSFORMER REGULATION; R. D. Mershon, of New York, N. Y. App. filed October 31, 1896. A system of electrical distribution comprising an alternating-current circuit provided with inductive resistance, and a rotary transformer provided with means for varying the ampere-turns of the field-magnet winding or windings in order to vary the electromotive force at the direct-current terminals.

620,365. MEANS FOR AND METHOD OF ELECTROMOTIVE-FORCE REGULATION; N. Rowe, of Wilkinsburg, Pa. App. filed January 27, 1898. The combination with a stationary transformer having a divided winding of a switch or switches for cutting the divisions of the winding into or out of circuit successively, and means for inductively varying the electromotive force between operations of the switch which effects changes in the length of the winding.

620,440. TELEPHONE SWITCH; W. D. Gharky, of Philadelphia, Pa. App. filed June 16, 1898. Subscriber's telephone apparatus, including transmitting and receiving instruments, main and local circuits; independent switches for said circuits, and means whereby the weight of the receiver may automatically operate either of them as occasion requires, substantially as described.

620,473. ELECTRICAL MACHINE; G. F. Martin, Corydon, Indiana. App. filed July 18, 1898. In an electrical machine, a stationary armature-plate and a movable motor-plate, and means for adjusting the armature-plate.

620,491. TELEPHONE SWITCHBOARD; J. M. Overshiner, of Elwood, Indiana. App. filed January 24, 1898. The combination with a jack and a drop, of a plug to enter the jack and an engaging device on the plug adapted to co-operate with the drop to restore it as the plug is inserted into the jack, and also while it is being withdrawn therefrom.

620,514. POTENTIAL REGULATOR FOR DYNAMOS; A. A. Tirrill, of Whitefield, N. H. App. filed April 28, 1898. In a potential regulator for dynamos, the combination with the solenoid-coils, their cores, and levers having contact points, the inner ends of said levers being lapped and the upper one having a spring to draw it down and a rotary disc or roller resting upon the lower lever, said disc being arranged in the plane of the levers to form a sensitive articulation, substantially as described.

620,547. SIGNAL SYSTEM; E. L. Hail and George Hail, of Providence, R. I. App. filed August 17, 1897. A switch, comprising a base, a lever pivoted thereto, and adapted to engage one or more contacts on said base, and provisions for permitting or causing said lever to move yieldingly in either direction past said contacts, and automatically return to the contact last passed by it.

620,549. ELECTRIC RAILWAY; J. F. Munsie, of New York, N. Y. App. filed February 25, 1898. An electric railway system, comprising a grooved rail extending along the line of way and provided with flanges, a collector carried by the traveling vehicle adapted to traverse the groove, and wearing shoes on said collector rail adapted to engage the flanges.

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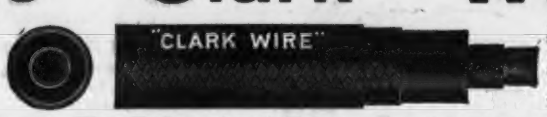

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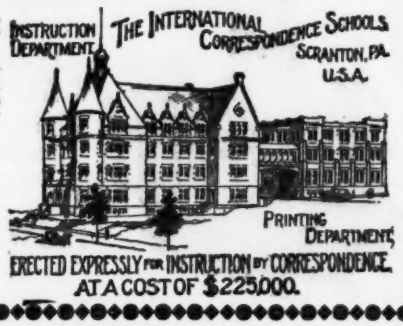

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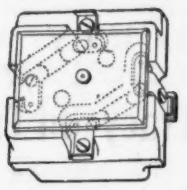

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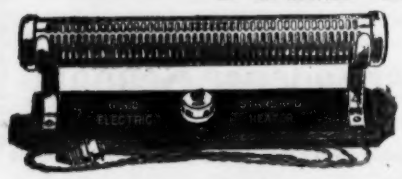

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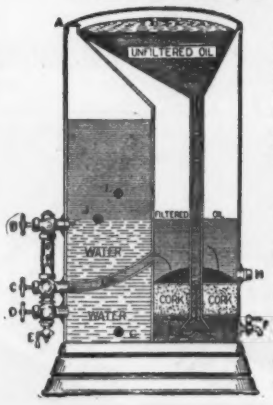

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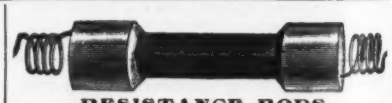

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